FEBRUARY 1966

Radio control Models and electronics

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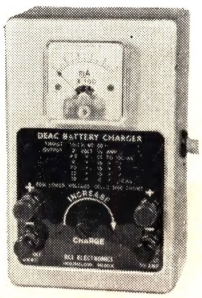

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Radio control Models and electronics

FEBRUARY 1966

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MAP HOBBY MAGAZINE

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LIONEL HARRIS

Editorial and Advertisement Offices

13-35 Bridge Street, Hemel Hempstead, Herts

Tel.: **Hemel Hempstead 2501** (Mon.-Fri.)

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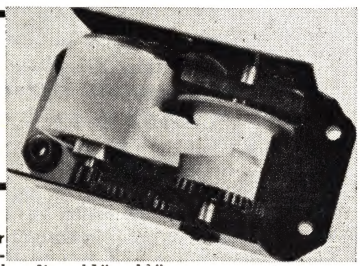

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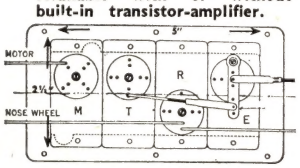

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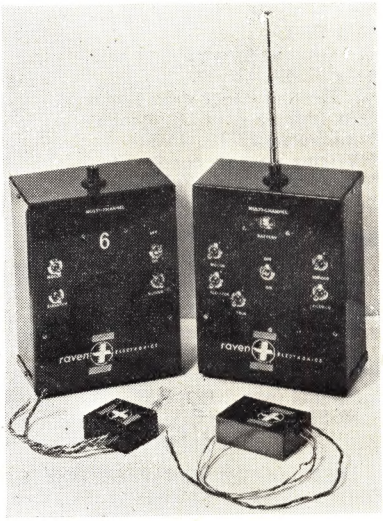

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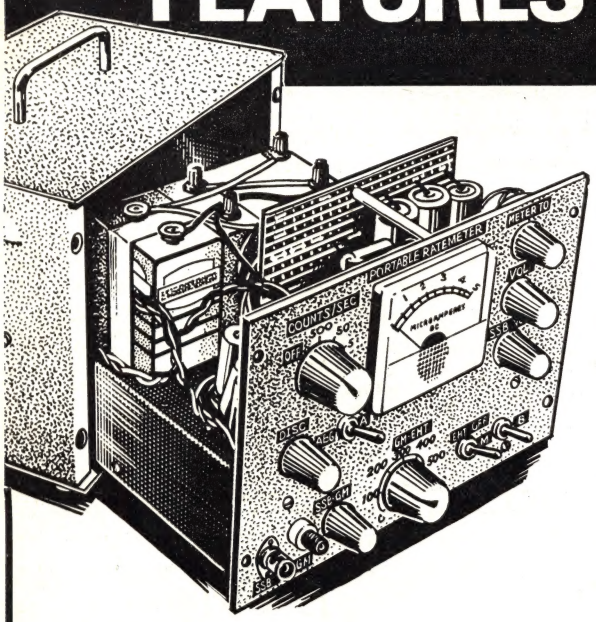

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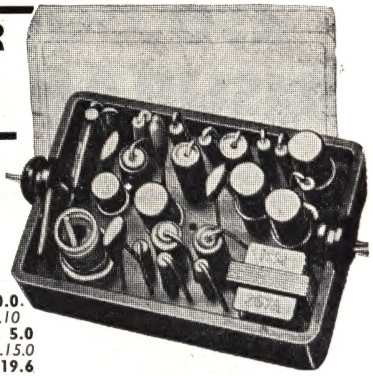

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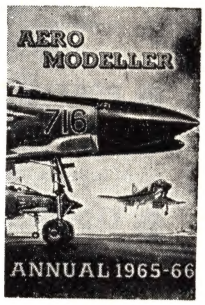

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Here, There and Everywhere

Battling Birds

FOLLOWING up the Reeves report on page 11 last month, P. J. Horrill, of Somerset, sent us this this report:

The ornithological story in the last issue brings back vividly our own experience with Herons.

There's about half a dozen regular multi fliers who make use of a disused airfield at Henstridge by kind permission of the owner. Henstridge is in Dorset just off the A30, it's a fine place to fly from and well away from any villages that might resent the sound of our 8 and 10 cc. engines.

One day last summer (what summer?) I was flying a V.K. Challenger powered by a Super Tigre 56 and that combination moves, when a lone Heron appeared in the sky, the temptation was too great and the Challenger was sent in persuit of this ungainly bird with a wing span of nearly 6 ft., very long neck and equally long legs. He was soon overhauled and passed, apparently not noticing the invading aircraft but a swift Immelman seemed to scare the life out of him, his neck stretched out and down (down trim) and wings frantically increased beats (full engine) to carry him on his course out of safe R/C range.

Several weeks later we were again at Henstridge when presumably the same heron hove into view. The only model in the air was a G String, S.T. 51 powered, a highly manoeuvreable aircraft which the pilot soon directed into the vicinity of the heron. The bird was at first unperturbed but after a few passes he suddenly dived rapidly on the offending G String as it passed underneath. There followed a very swift exchange of manoeuvres at about 100 ft. over the runway, a real war time dog fight (or bird fight), during which that bird executed a couple of the most perfect and effortless reversals you could wish to see, faster than the G String was capable of and in the end our pilot withdrew and gave the heron best. I guess that bird learnt a thing or two from his first encounter with R/C models and had been practicing since. He was later seen to join a second heron in the air at the airfield perimeter and you could almost hear the laughter from these two ungainly birds.

Incidentally we are now equipped with a couple of American type interceptor fighter jets, the F9 (see page 85) and the Jetfire so watch out Herons, Buzzards and Seagulls.

Rolls Royce Pylon Race 1966

Writing this as we do just before the Christmas Holidays it seems a little premature to be considering the 1966 contest programme, but obviously some of the enterprising radio control clubs already have their programme in hand.

Rolls Royce (Welfare) M.A.C. will again be organising their popular Pylon Race Rally in 1966, having set the date for April 3rd. Provided the response warrants it, there will be four events covering single channel, Pylon Racers (either 2.5 cc. or open), Multi Relay race and a Scale or Semi-Scale section.

This event will be held at its usual venue on Rolls Royce M.A.C.'s flying field at Thulston Field, near Derby.

Goodyear Racers Go-Ahead

It seems last September's issue with its dig at leading R/C clubs to take the plunge in organising rallies to cater for the new Goodyear Pylon Racing event has had the right effect on Bristol Radio Control M.A.C., who have come forward with a proposal for a series of rallies in which this class will be very much to the fore.

Bristol M.A.C.'s main event will be their annual rally, which this year will take place at R.A.F. Colerne, near Bath on June 19th, and will be held in conjunction with the Bath Festival, as one of the fringe events.

To this end, the main attraction will be a Goodyear Pylon Race event, for which about £90 will be available as prize money with £40 for 1st place, £20 for 2nd and £15 3rd prize. Prizes for Multi and Scale, which are the other two events, will also be generous.

To give intending Goodyear enthusiasts a chance to aquaint themselves with this kind of event which has never so far been organised in this country, Bristol M.A.C. will also be organising a preliminary Goodyear race on Easter Monday—April 11th at R.A.F. Hullavington, Wilts. This should certainly be a "taster" of the thrills of Goodyear racing and as an added attraction to encourage a large entry there will be £30 in "starting money" to be distributed equally among all competitors who complete an official race.

So what are you waiting for—go build a Goodyear racer—now!

On The Cover

Artist Laurie Bagley shows what might happen if radio controlled hovercraft became as active a hobby as we would like to see. With plenty of propulsion power, outdoor operation might become just as feasible as the present projected indoor type of course. See page 64.

NEW WORLD RECORD

On November 14th last, Geoff. Brooke-Smith, of the Cape Radio Fliers, South Africa, set up a new absolute world duration record for radio control models of 11 hrs. 33 min. 28 secs., from 07.11 a.m. to 6.43 p.m.! To achieve this tremendous air-time Geoff. used a 98 in. span slope soaring glider.

The record attempt model had a wing area of no less than 936 sq. in., using a semi-symmetrical 13 per cent thickness wing section. The symmetrical section tailplane added another 170 sq. in. to the 5¼ lbs. model. The transmitter was an Orbit 12, the receiver was a Min-X 10, applied to the full span strip ailerons, elevator and elevator trim.

Flown in the Tygerberg Hills, near Capetown, the record attempt proceded under the approach path of the D.F. Malan Airport, as Boeing 707's and 727's passed low overhead. The attempt has now been officially ratified by the F.A.I. as an absolute world duration record for radio control models.

At right we see the triumphant pilot Geoff. Brooke-Smith with his model flanked left to right by P. Duffy, S. McCullagh, B. Moore and T. Loxton.

HOVERCRAFT FOR R/C

Design notes by D. A. WARD

DURING the summer of 1963, I was asked to assist, primarily on the radio control side, with production of an R/C model Hovercraft for a public exhibition. The already chosen design was that of SRN-1, (obtained through M.M. Plans Service MM/583) and intended for "free-flight" (?).

I chose single channel pulse proportional being the easiest to construct in the limited time available. The transmitter and pulser were "home-grown", the receiver circuit from "Model Boat Radio Control" and the servo constructed from an electricity meter gearbox and a Kako motor. The equipment was constructed integrally with the superstructure whilst a small cabin aft housed the servo and servo batteries. The rudders were very simply coupled to the servo with piano wire linkage and the model was taken for a test flight.

The control results were extremely discouraging. The craft hovered beautifully but directional control was nearly non-existent. The rudders merely served to adjust the orientation of the model with respect to its direction of travel, and then only after a considerable delay. It was still almost free-flight!

Hurried experiments took place and first the engine, an E.D. Racer, was replaced by an E.D. Hunter, to provide extra lift and thrust for the modifications we envisaged. The ducts were modified as in Fig. 1. and a suitable linkage designed so that turns were executed by rotating the hovercraft about its centre, i.e. for a turn to starboard, the starboard duct flap moved to the aft position, the port flap stayed in its normal position, forward, with vice-versa for port turns.

It was later found to be necessary to couple the rudders to the linkage to provide visual indication to the driver, of the flap positions. Trials proved this to be a very effective method of steering, but also proved that an accurate linkage was necessary. Slowness of response of trim (50/50 mark/space variation) for direction stability. Slight "bleeding" of ducts was overcome by reducing the M/S rate to 5 cycles per second. At last it became an extremely versatile craft, with the ability to turn in its own length, and, by juggling with the control stick (which merely operated micro-switches to switch from 50/50 M/S to 20/80 or 80/20) it was possible to stop the model.

By this time, the weight of the model was 10·1 lbs. but it was extremely stable. On uneven ground, due to reduced hover-height, it grounded occasionally. To overcome this, as no weight reduction appeared possible, a 1 in. deep flexible skirt of polythene was used, which formed an extention to the plenum chamber. Obstruction now lifted the skirt and no further troubles were experienced, even with stones 1½ in. high. It was possible, with a short run, to climb a 2 in. stepped surface.

The course used for the exhibition is shown in Fig. 3. Rather ambitious, but the model performed very well, the radio behaving itself perfectly all through the nearly continuous exhibition which lasted 5½ hours. One mishap bore out the fact that the rudders are functionally useless. A collision with a barrier caused the loss of *both* rudders, with no effect upon handling. The course had a very slight slope, about 1-in-100, but it affected the craft more than expected. On the downward run, a speed in excess of approximately 10 knots. was achieved, and on the "upward" run, a speed of about 3 knots. was average. Skillful handling was necessary to overcome the difficult associated steering problems.

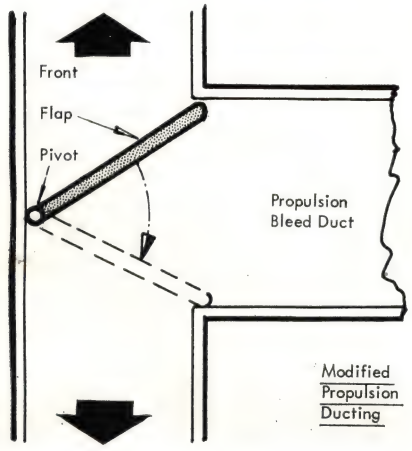
After the exhibition, enthusiasm was at its height on our part for a model designed to overcome the problems encountered. In the light of further experiments (and our experiences) we drew the following conclusions:

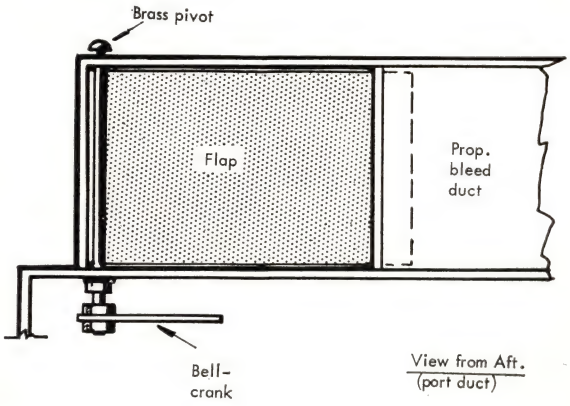
1. For stability reasons, and for ease of manoeuvrability, the shape of the craft should be rather more rectangular, length-to-width at least in a ratio of 3:2.

2. Like aircraft, to prevent drift when turning, due to momentum, it is necessary to apply "bank", so that the craft tends to "roll off" its "bubble" of air (see Fig. 5A).

3. Separate motors are to be preferred for propulsion,

FIG. 1





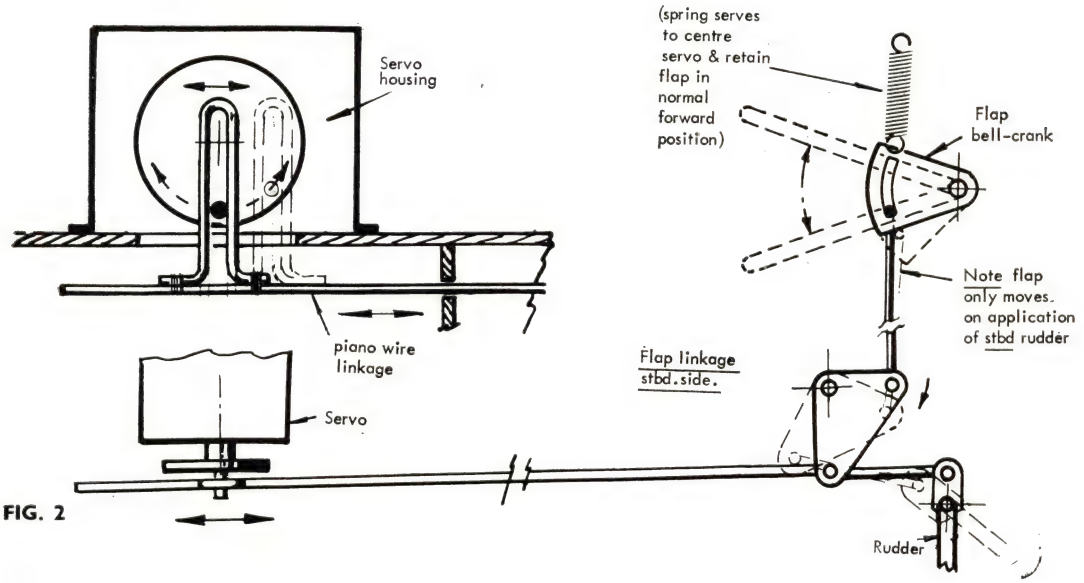

Servo housing
piano wire linkage
Servo
(spring serves to centre servo & retain flap in normal forward position)
Flap bell-crank
Note flap only moves on application of stbd rudder
Flap linkage stbd. side.
Rudder

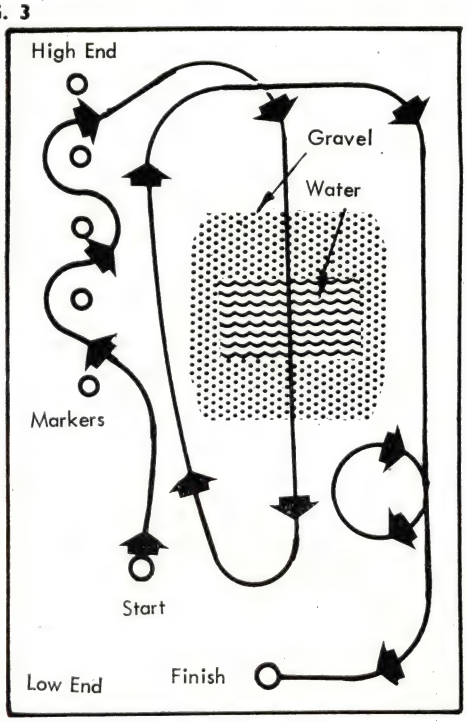
FIG. 2

or the ducting for steering should be applied in such a direction as to effect a reduction in velocity as well as to turn the craft.

The above could be embodied in the following manner:

1. The lift could be provided by two separate plenum chambers, either fed by separate motors or by a common motor. This immediately gives both stability and facilitates the required shape.

FIG. 3



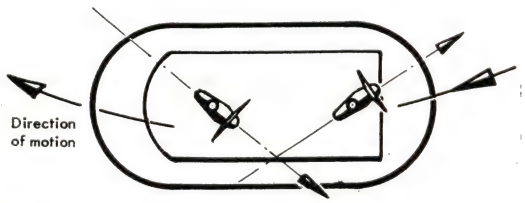


FIG. 4

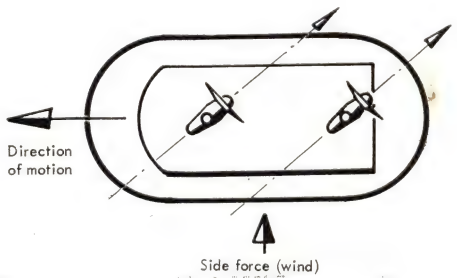
2. The answer becomes more evident after consideration of:

3. Two motors mounted externally as "pushers" can fulfil steering and bank requirements. By moving the motors as shown in Fig. 4 steering is effected. By moving them as in Fig. 5, drift can be countered, that is, drift due to any circumstances, such as side wind or slope of surface. By mounting the forward motor higher than the after one, leverage is applied so as to tilt the craft, assisting the turn as required in 2, shown in Fig. 5A.

If ducting is preferred for steering purposes (to avoid the possibility of fingerless hovercraft enthusiasts) each plenum chamber could supply a duct, the after chamber

(Continued on page 89)

FIG. 5



I've got a Mini Power Boat in my tank!

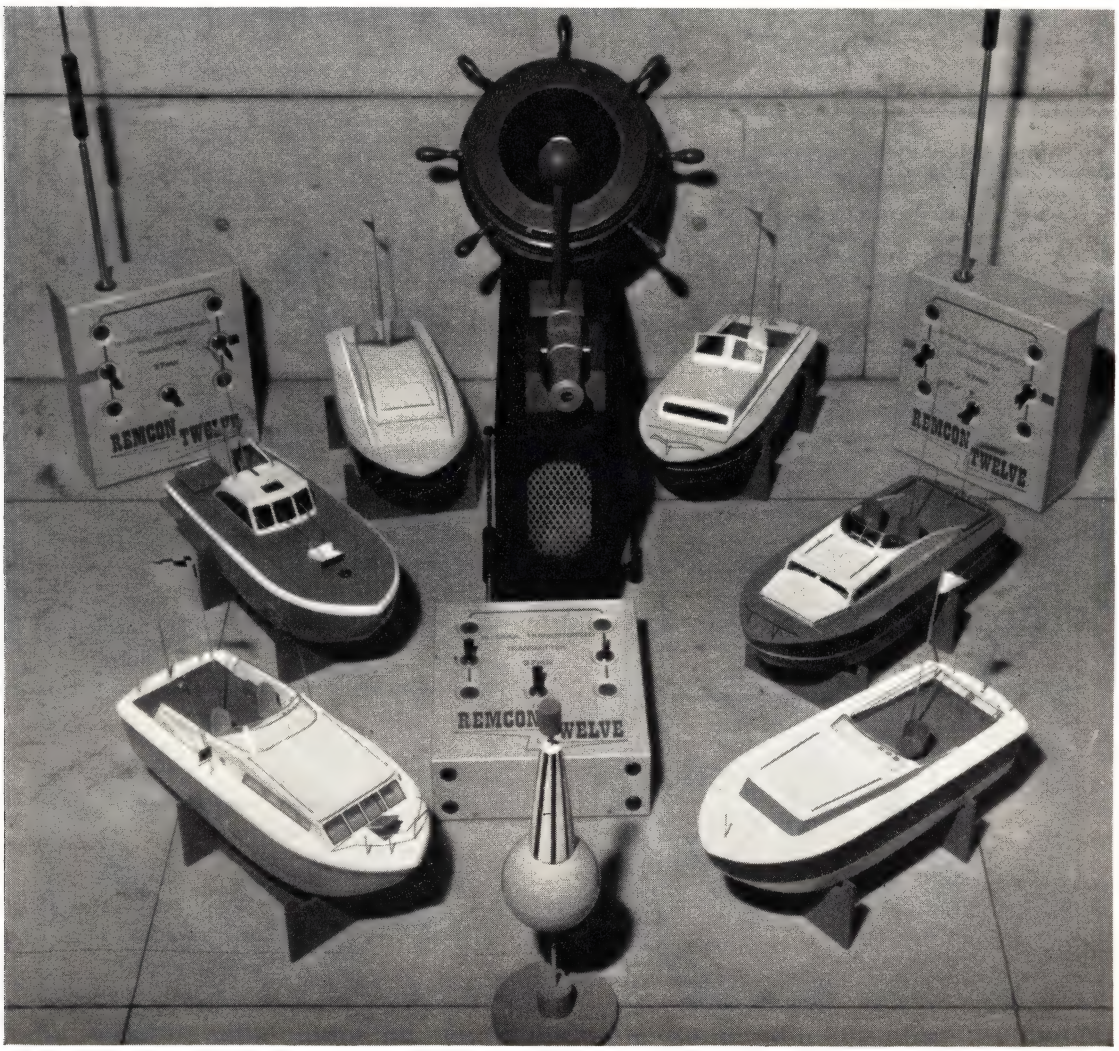
Geoff Chapman describes the Boat Show R/C models

AT the 1966 International Boat Show the Shell-Mex and B.P. Stand will, as last year, be devoted to Off-shore Mini Power Boat racing.

These boats are of interest to us since they are radio controlled, and produced as a joint project by Messrs. Partridge Models Limited and Remcon Electronics Limited.

The races are held in a closed circuit around a relief model of the Isle of Wight some 20 ft. × 12 ft. set in a tank 70 ft. × 30 ft. approximately 4 inches deep. The races are started by firing a cannon which also releases the arrester wire, holding the boats with motors running. The on/off switches on the boats are arranged so that their extended toggles serve as aerials, and on running into the arrester wire, switch off the motors and radio.

As can be seen from the accompanying layout these



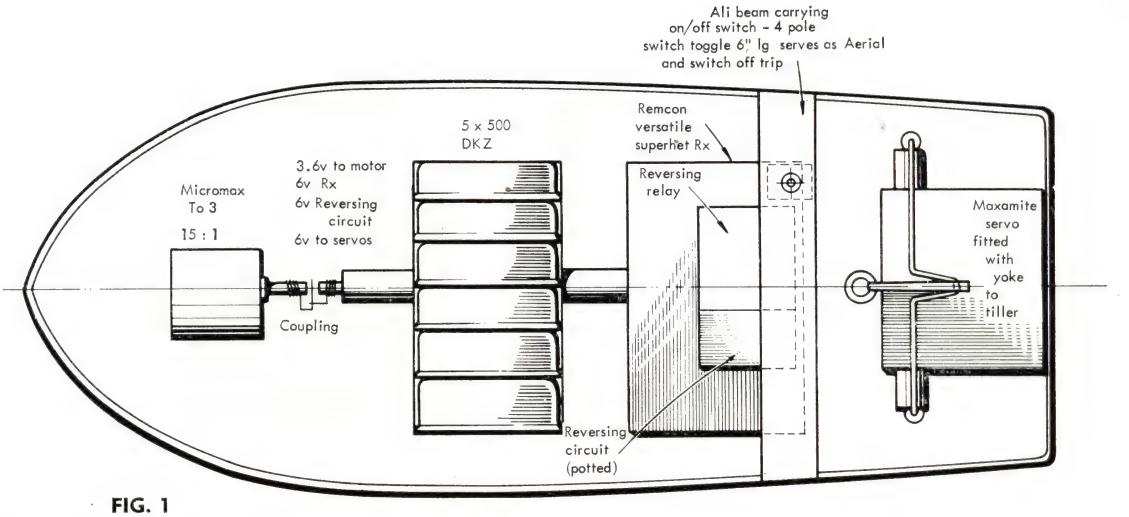
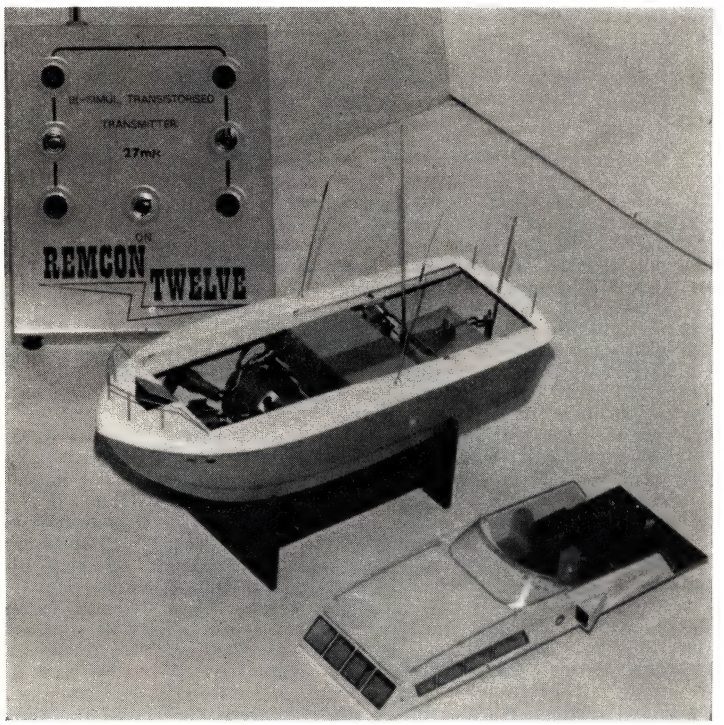


FIG. 1

boats are real miniature power houses which are able to run continuously for 5–6 hours between recharging.

The original design allowed for up to 12 boats each fitted with 6 channels to be operated simultaneously—this is arranged by using each of our six spot frequencies, and using the normal Remcon Tx in the simultaneous mode permanently. In actual fact only six boats are run at one time since it was felt that this is the number which can be properly managed, even so, only 3 Tx's are used to control the six boats, which speaks well of the simultaneous tone stability of the Remcon transmitter.

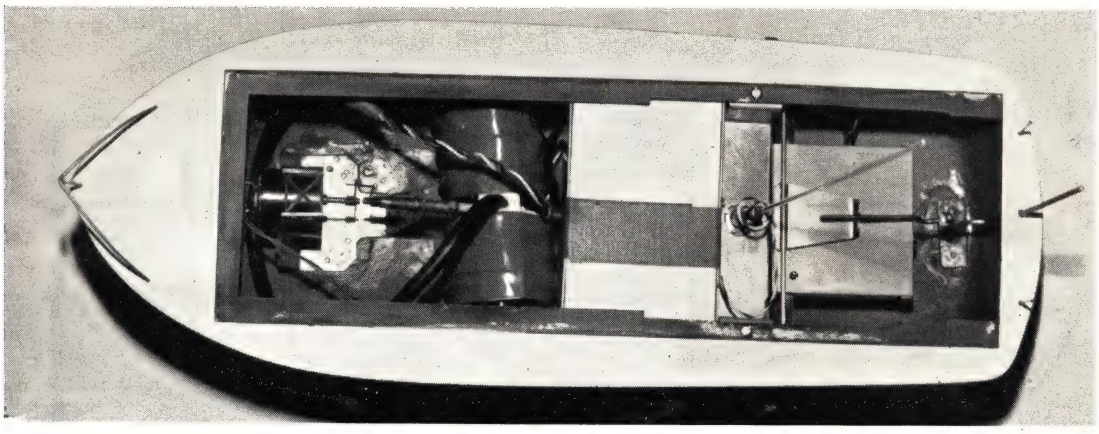
The main drive motors are Micromax T03, fitted with 15:1 gear boxes and are being operated on 3·6v. for top speed. (Fig. 1.) Under these conditions the motors have approximately 15 hours life, since they are being over-driven by some 50 per cent. The motors are capable of being reversed by a diminutive flip flop reversing circuit developed by Eric Hook. (Fig. 2.) This circuit may well prove useful to other boat modellers requiring reversing, providing the motor current does not exceed one amp. or so. The important feature is that the circuit consumes no current in one position, but on receiving



Left: the boats and transmitters arranged round the starting cannon and one of control wheels, the mechanism behind the latter being a biased off double throw switch to key the transmitter for steering. This "Daily Express" photograph was taken at a press demonstration held at the R.A.C. swimming pool.

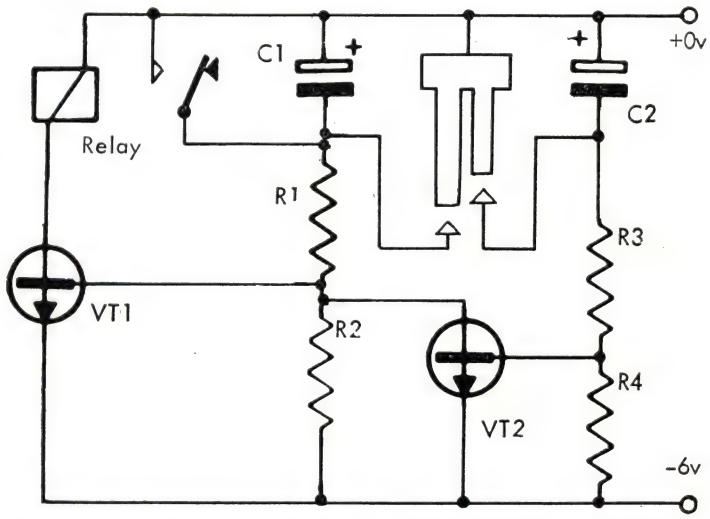
Fig. 1. above shows the layout of the latest Craft. Note how the rudder stock has been re-positioned forward of the Maximite to give greater rudder throw.

Photo right shows one of last year's Craft with its twin whip aerials and forward facing tiller.



Above: One of the earlier boats showing tiller linkage, motor mount and other items cement easily to the vacuum formed plastic hulls.

Fig. 2 shows a flip flop circuit, relay contact is additional to the change-over contacts for motor switching shown in Fig. 3.



Component Values

R1	:	1K
R2	:	2.2K
R3	:	1K
R4	:	2.2K
C1	:	10 μF
C2	:	10 μF
VT1	:	2N697
VT2	:	2N2926
Relay	:	PC4, 52Ω coil

FIG. 2

the merest "blip" from the "reverse" reed latches into the other position. Upon receipt of a "blip" on the "forward" reed the relay is released and the motor changes rotation. In this case forward is arranged to occur on the no current consumption position and vice versa. By using a double pole change over network the use of a centre tapped battery is avoided, and with it the risk of unequal discharging. (Fig. 3).

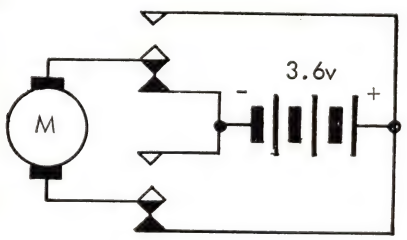


FIG. 3

The Receivers are standard Remcon Versatile Superhets fitted with Deans 10 reed banks which have proved themselves most reliable in this application. The 6 receivers are aligned as 3 pairs to the 3 Tx's and the reed banks used so that there are 4 channels plus 1 spare reed position in each boat. Although the boats start off side by side under virtually swamp R.F. conditions there is no inter-action between them.

The servos are self-centring Maximites fitted with positive trigger Bonner type amplifiers which were chosen because of the current switched by the reed when driving these amplifiers is about one hundredth of that when driving a TASA amplifier. Examination of the reeds after the 1965 Boat Show showed there were no signs of electrical pitting, and this was after many tens of thousands of operations—probably equal to a normal modelling lifetime. As a point of interest it was calculated these boats each covered over 100 miles under their own power.

The linear output of the servo is transferred to the tiller via a yoke necessitated by the cramped stern conditions, and the need to bring the rudder near to its stall angle to effect a tight turn.

Judging by the continuous queue of boys of all ages there were at the Stand last year, all eager to have a go, it was obviously a worthwhile advertising venture for Shell-Mex and B.P. as well as a really tough assignment for Remcon equipment.

We look forward to seeing the more advanced boats at Earls Court this year (January 5th to January 15th) and who knows, have a go and win a race.

Pulsed Speed Control

a novel method by J. A. PALMER

THIS system is probably cheaper than a mechanically operated rheostat, and has the following advantages:

1. Smooth instantaneous response.
2. Almost linear (unlike mechanical control).
3. Low speed performance smoother.
4. No moving parts.
5. Realistic "tick over" at low speeds.
6. Fail safe, if model goes out of range.

The control is suitable for any bi-simultaneous transmitter, and can be used with a tuned reed, or filter receiver.

One channel of the transmitter is modulated with a variable mark-space ratio pulsed tone, which is transmitted simultaneously with the steering commands. The appropriate filter circuit (Fig. 1), VT1, converts the pulses of tone into pulses of D.C. which are applied through VT2 to power transistor VT3, switching it on and off in synchrony with the transmitter pulsing, thus the mark/space ratio will determine the mean D.C. voltage across the power transistor, and hence the speed of the motor. Capacitor C3 smooths out the pulsing across the motor.

Full-sized printed circuit diagram in figure 2, component placement in figure 3. Follow the component assembly schedule for speedy building.

If you have a reed receiver, then the circuit will require a feeder stage as shown in the theoretical circuit of fig. 3. In order to use the same p.c. board, the assembly schedule, shown in Fig 4 should be used.

(Continued on page 72)

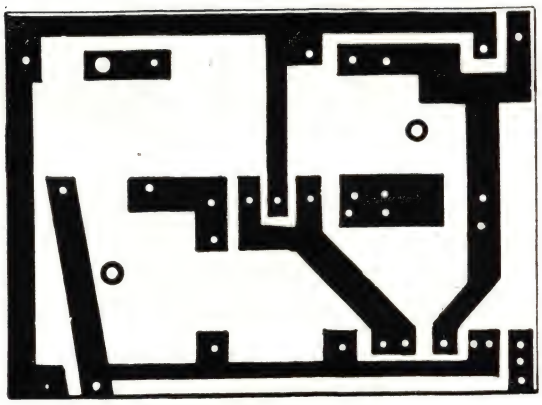


FIG. 2

FIG. 3

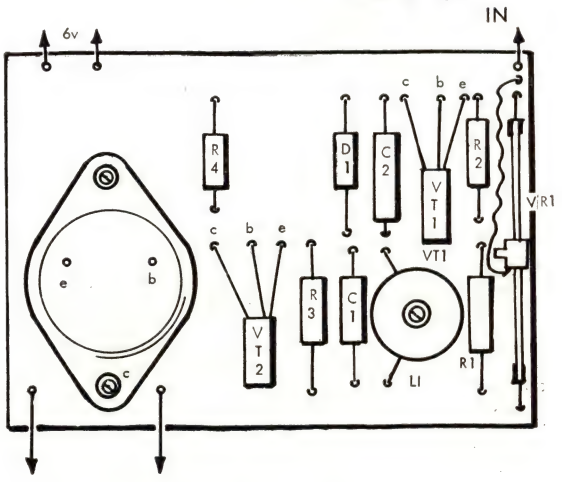
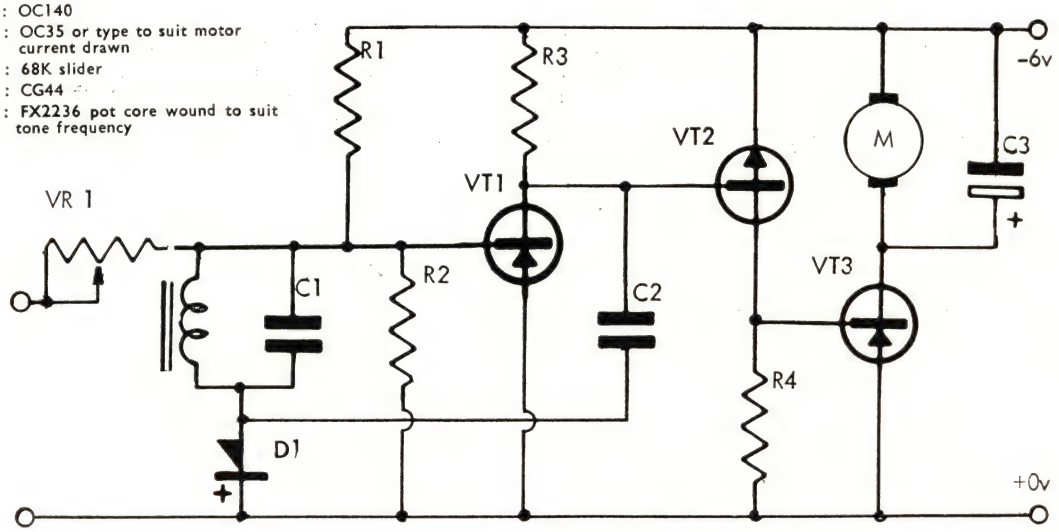


FIG. 1

VALUES

R1	:	330K
R2	:	4.7K
R3	:	3.3K
R4	:	330Ω
C1	:	To suit tone frequency
C2	:	.04 μF
C3	:	1 μF electrolytic
VT1	:	OC44
VT2	:	OC140
VT3	:	OC35 or type to suit motor current drawn
VR1	:	68K slider
D1	:	CG44
L1	:	FX2236 pot core wound to suit tone frequency



New F.A.I. aerobatic schedule

OR HOW TO SORT OUT THE MEN FROM THE BOYS!

We present the schedule in its entirety with descriptions and illustrations of each manoeuvre, specially drawn to avoid mis-interpretation. Keep these pages carefully.

AT the F.A.I. R/C sub-committee held November, 1965, proposals were made for amending the existing stunt schedule. Many manoeuvres, it would seem, have been devised in substitution for some of the existing items in the schedule. It certainly looked quite attractive and was devised with the following three main requirements in mind.

1) It should be considerably more difficult than the previous schedule.
2) It should enable the full schedule, including engine starting, to be accomplished in ten minutes.
3) It should last at least three Championships, i.e. six years, in order to avoid further alteration in that time.

There were some particularly attractive looking substitutions for example the double stall turn, combined immelmans and top hat. Some items have been modified and we have identified these with an asterisk. The new manoeuvres are prefixed with a spot. K factors have been changed somewhat and the schedule must be complete from commencement of starting engine in ten minutes.

Our comments . . . wot! No touch and go. If this was squeezed in even towards the end of the flight it might prove the pilots skill a little more without bringing the flight to an unduly premature end.

"Proposed New Schedule Of Manoeuvres For Radio Controlled Powered Models, Class F3 A Multi Controlled.

The manoeuvres must be executed in the order in which they are listed and the Competitor must indicate in writing, before the start of the flight, any manoeuvres he will not execute.

The start of each manoeuvre must be indicated by the pilot or his assistant. The manoeuvres of take-off and landing need not be signalled, but must be executed in an uninterrupted manner.

The Competitor may only make one attempt to execute each figure during any one flight.

The pilot has 10 minutes in which to complete the programme of manoeuvres from the moment he receives the signal to start the engine.

* 5.4.1. **TAKE-OFF.** The model must stand still on the ground with the engine running without being held by the pilot or the mechanic and must take off into wind.
K=5

• 5.4.2. **DOUBLE STALL TURNS.** The model starts in level flight, noses up to the vertical attitude, yaws through 180 deg., then dives and makes one half of an inverted loop into vertical flight, then yaws through 180 deg. again, finally recovering into upright level flight at the same height and on the same heading as the entry.
K=15

• 5.4.3. **COMBINED IMMELMAN AND INVERTED IMMELAN.** The model starts in level straight flight, pulls up into a half loop followed by a half roll, flies straight and level for approximately one second then makes half an outside loop followed by half a roll, recovering in straight level flight.
K=10

5.4.4. **LOOPS.** The model starts the Loops manoeuvre flying straight and level, then pulls up into a smooth, round loop, followed by a second and third loop in exactly the same path with a straight and level recovery to finish.
K=10
NOTE.—Loops must appear round and super-imposed to the ground-observer even in the presence of the wind.

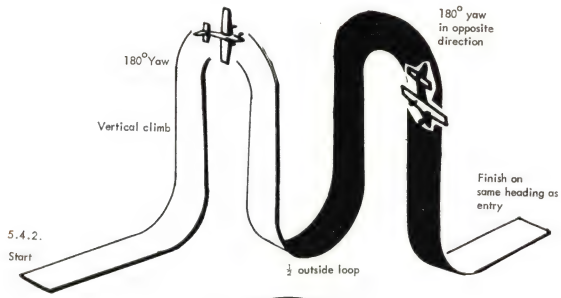
5.4.5. **INVERTED LOOPS.** The model commences the Inverted loop flying straight and level, then noses down into Inverted Loops and recovers flying straight and level on the same heading and altitude as the entry.
K=10

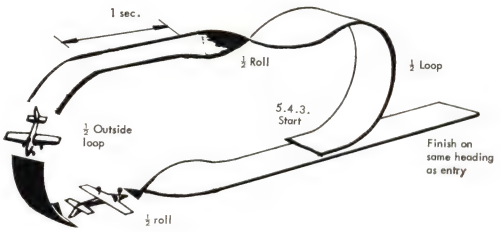
• 5.4.6. **ROLLS.** Model starts from straight and level flight then rolls at a uniform rate through three complete rotations and finishes in staight level flight all on the original heading, the time of the three rolls to be approximately 4 secs.
K=10

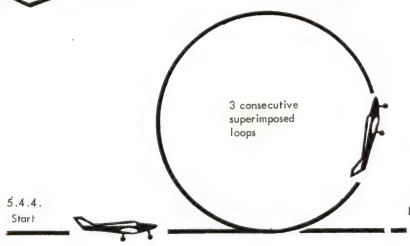
• 5.4.6. **SLOW ROLL.** Model commences from straight and level flight then rolls slowly at a uniform rate through one complete rotation the approximate time of the roll to be 5 secs.
K=15

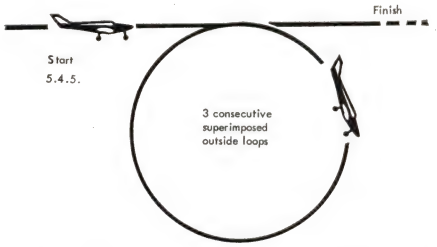
• 5.4.7. **ROLLING CIRCLE.** Model commences in level flight, makes half a roll into inverted circular flight, subsequently making a further half-roll at each quadrant of the circle so that the model flies alternately upright and inverted in consecutive quadrants. The model recovers in straight level flight on the same heading and at the same height as the entry.
K=15

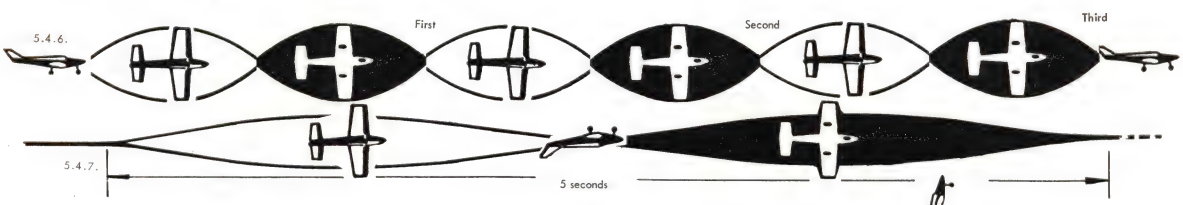
5.4.1.
Model free standing and stationary

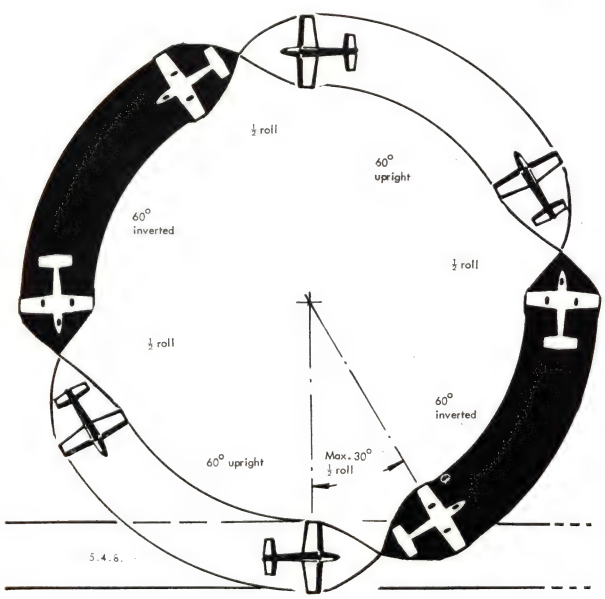

180° yaw in opposite direction
180° Yaw
Vertical climb
Finish on same heading as entry
5.4.2.
Start
½ outside loop

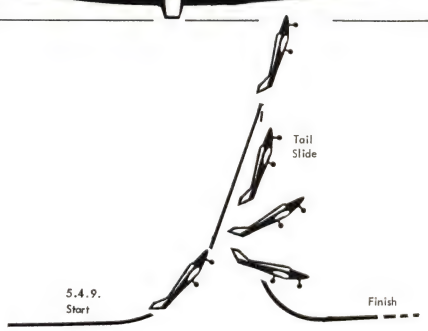

1 sec.
½ Roll
½ Loop
5.4.3.
Start
½ Outside loop
Finish on same heading as entry
½ roll

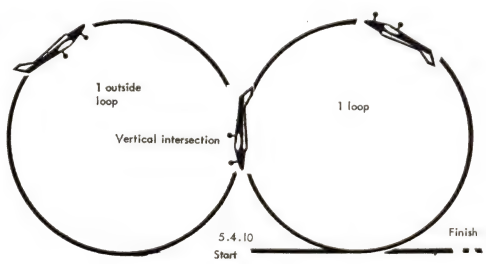

3 consecutive superimposed loops
5.4.4.
Start
Finish


Finish
Start
5.4.5.
3 consecutive superimposed outside loops


5.4.6.
First
Second
Third
5.4.7.
5 seconds


½ roll
60° upright
60° inverted
½ roll
½ roll
60° inverted
60° upright
Max. 30° ½ roll
5.4.8.


Tail Slide
5.4.9.
Start
Finish


1 outside loop
1 loop
Vertical intersection
5.4.10
Start
Finish

5.4.9. **TAIL SLIDE.** The Tail Slide commences with straight and level flight, pulls up to a vertical position, slides downward tail first for two plane-lengths, recovers in a right-side-up position and finishes in straight and level flight at the same altitude as the entry.

K=15

5.4.10. **HORIZONTAL EIGHT.** The plane commences flying straight and level, pulls up into $\frac{3}{4}$ of an inside loop, does one full inverted loop starting from straight down, then $\frac{1}{4}$ of an inside loop finishing in straight and level flight.

K=8

5.4.11. **CUBAN EIGHT.** The plane commences flying straight and level, pulls up into an inside loop and continues until heading downward at 45°, does half roll followed by another inside loop to 45°, does half roll followed by straight and level recovery at same altitude of entry.

K=6

5.4.12. **VERTICAL EIGHT.** The plane commences the Vertical Eight flying straight and level, pulls up into one complete inside loop, follows with one inverted loop and recovers straight and level at the same altitude of entry.

K=10

* 5.4.13. **INVERTED STRAIGHT FLIGHT.** The model started level and upright, makes a half roll to inverted, flies straight and level inverted for a minimum of 5 secs. and recovers with a half roll to the upright position.

K=8

5.4.14. **INVERTED EIGHT.** The plane commences the Inverted Eight flying straight and level inverted, turns left one complete circle, turns right one complete circle, flys straight and level in the same direction as the entry still inverted.

K=15

* 5.4.15. **TOP HAT.** Model starts in straight level flight, pulls up into a vertical climb and makes a half roll, then levels out inverted on same heading as entry. After short inverted flight model dives vertically, performs a half roll and finally recovers in straight level flight on same heading and height as entry.

K=15

5.4.16. **SPINS.** The plane establishes a heading direction by flying straight and level, pulls up into a stall and commences the spin through one, two, three turns and recovers to level flight on the same heading as the initial flight direction.

K=8

5.4.17. **RECTANGULAR APPROACH.** The Rectangular Approach is commenced with the model flying into the wind above the landing circle, a left turn of 90°, a cross-wind leg, a second left turn of 90°, a down-wind leg, a third left turn of 90°, a cross-wind leg, a fourth of 90° and straight flight toward the point of touch-down. The manoeuvre is finished just prior to the point of touch-down. The direction of the manoeuvre will be determined before each round in accordance with safety regulations.

K=10

* 5.4.18. **LANDING.** The model flares smoothly to touch to ground with no bouncing and rolls to a stop.

K= 10 for landing in the 25m circle.
K= 5 for landing in the 50m circle.
K= 0 for landing outside the 50m circle.

Total maximum points 2,000.

Manoeuvres Deleted

STRAIGHT FLIGHT
TURNS
STRAIGHT RETURN FLIGHT
STALL TURN
IMMELMAN TURN
REVERSAL
OPPOSITE ROLL
VERTICAL ROLL

PULSED SPEED CONTROL *(Continued from page 69)*

Pulse requirements

For maximum speed variation the pulser should be capable of producing full mark (maximum speed) to full space (motor stopped).

As the motor is receiving pulses of D.C., it will run at a much lower speed than would be possible by using a variable rheostat. Additionally, if the model should get out of range, the motor will stop, but would start again as soon as the operator moved into range (useful for range checks! !)

Values Fig. 4

R1	:	3.3K
R2	:	330Ω
C1	:	100 μF electrolytic
VT1	:	OC44
VT2	:	OC140

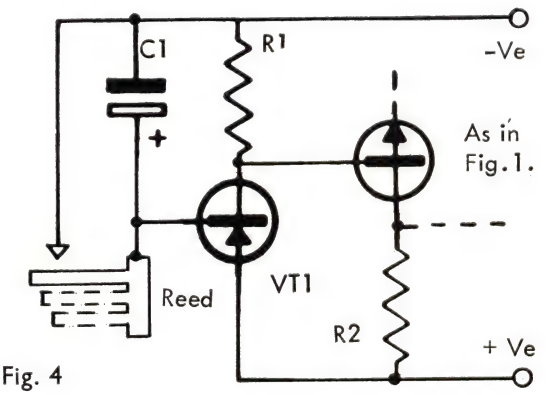
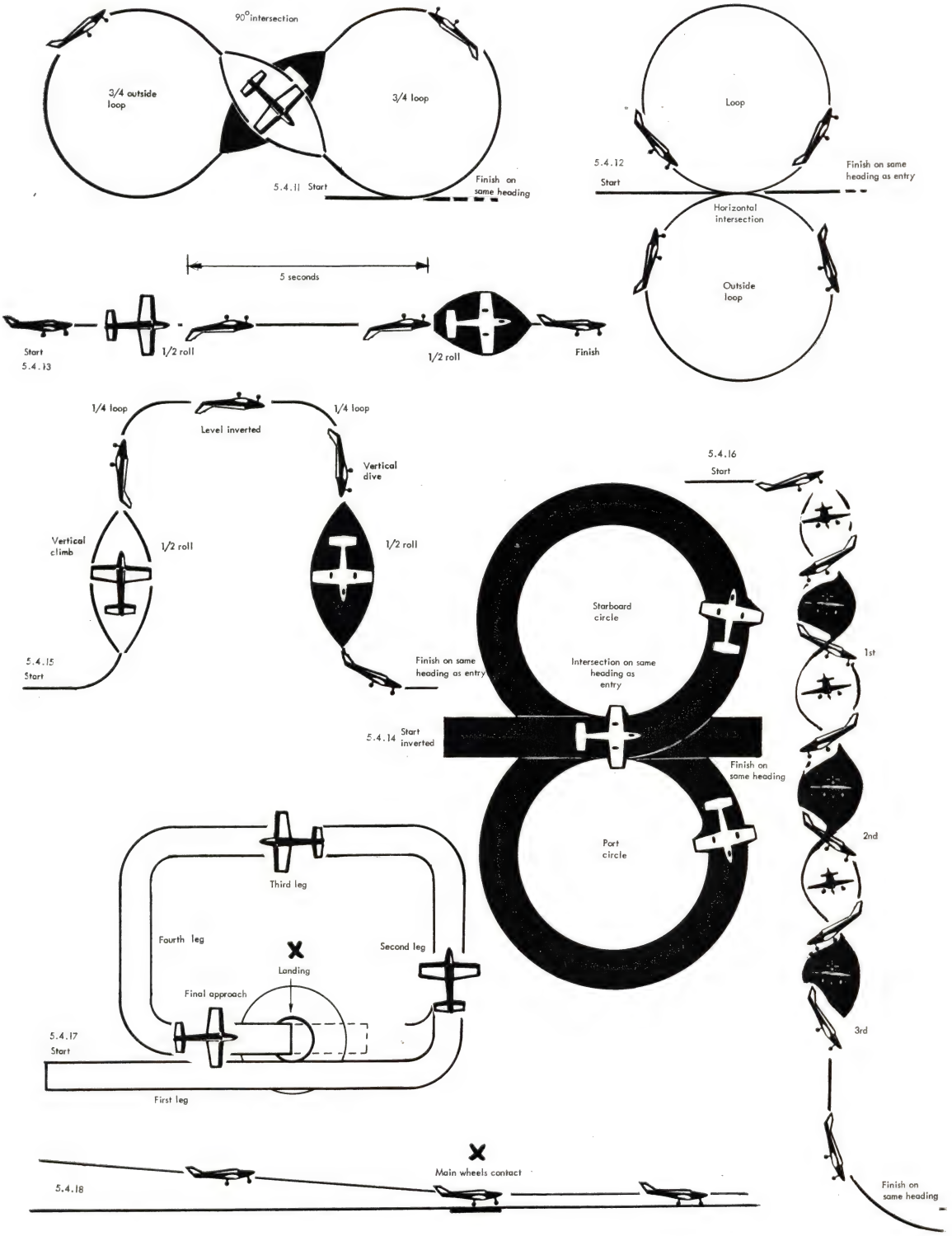


Fig. 4


90° intersection
3/4 outside loop
3/4 loop
5.4.11 Start
Finish on same heading
Loop
5.4.12
Start
Finish on same heading as entry
Horizontal intersection
Outside loop
5 seconds
Start
5.4.13
1/2 roll
1/2 roll
Finish
1/4 loop
Level inverted
1/4 loop
Vertical dive
Vertical climb
1/2 roll
1/2 roll
5.4.15
Start
Finish on same heading as entry
5.4.16
Start
Starboard circle
Intersection on same heading as entry
5.4.14 Start inverted
Finish on same heading
Port circle
1st
2nd
3rd
Finish on same heading
Third leg
Fourth leg
Second leg
Landing
Final approach
5.4.17
Start
First leg
Main wheels contact
5.4.18

GADGETS & GIMMICRY

Bright ideas from our Readers

Versatile iron stand

A SOLDERING iron should, between dabs at the circuit, be placed on a stand which acts as a heat sink. This prevents the iron overheating and should ensure that the iron does not unnecessarily cook its surrounding area on the bench. Some people rest the iron in an old tin can, others use a large pair of pliers which get surprisingly hot. This idea by D. A. Pollard uses a 6 × 3 × 3 in. baking tin. A scrap of aluminium formed into a channel is bolted to one end so that it overhangs the inside of the box. The tin also makes a useful recepticle for the cleaning sponge, splashes of "used" solder, dud components and other oddments.

Priming

A priming port in a silencer should be covered when the engine is running in order that the silencer operates efficiently. Typical example illustrated by H. S. Murgatroyd is the Webra barrel type which may be drilled opposite the exhaust adaptor for priming. He finds that an oil filler clip of the type normally used on bicycle wheel hubs will fit nicely over the silencer barrel and when slid into position over the priming hole, prevents leakage. The clips are available from cycle shops as a spare part and are obtainable in various sizes, so take the silencer with you when selecting one.

Remember to tilt the model when priming so that the fuel is directed into the cylinder and not into the bottom of the silencer.

Noseleg Collar

If you find that engine vibration loosens the retaining collar on steerable noselegs such as the Top Flite type D. Redrup's suggestion may be useful.

Soften the top of the leg at the extreme tip and cut a thread for about 3/16 in. Find a scrap of nylon propeller and cut the quadrant shaped collar from it. Drill it undersize so that the threaded end of the noseleg cuts its own thread in the nylon, which then becomes locked firmly in place and is unlikely to be disturbed by vibration. The leg can be removed by unscrewing when necessary.

Magnetic hatches

Suitable clips for retaining hatches and cowlings on radio models may get left until the last, when various pieces of bent piano wire, rubber bands or clock springs are pressed into service. Sometimes one forgets that a loose metal to metal contact on the bent wire type of hatch may cause interference with some over-sensitive receivers.

A radio model is the subject of the rather more prolonged use than the average machine, if you are a good pilot, consequently a hatch catch should be fuel proof and durable. R. Grimmett uses a very simple vibration resistant method of retaining hatches which is neat in appearance and unlikely to become damaged in normal use.

Following the popular trend among do-it-yourself carpenters he has applied the magnetic door catch idea to his model. In this application, a scrap of magnet is embedded in each side of the fuselage hatch, facing a correspondingly placed piece of tinplate fixed with contact adhesive to the underside of the hatch. Small dowells locate the forward end of the hatch and the magnetic device is about ¾ of the way back.

Few modellers, we discover, realise the value of magnetic attachment, there are many other applications in other models; contest, scale or even architectural. Suitable pieces of bar magnet may be obtained from Cockrobin Controls or by canabalising cheap electric motors.

DEAC protection

An idea from "Welsh Bleeps" concerns the protection of DEAC cells in a model installation. With care, we should think, this method would even waterproof a battery pack in a boat installation. Take a couple of Lepages p.v.a. white glue bottles and cut the top end of each away. Insert the DEACs into one bottle passing the leads through an undersize hole in the bottom, take a broad slice from the other bottle soak it in hot water so that it may be expanded to fit over the first bottle. The second bottle is then slid under this sleeve to complete a neat plastic covering for the DEAC.

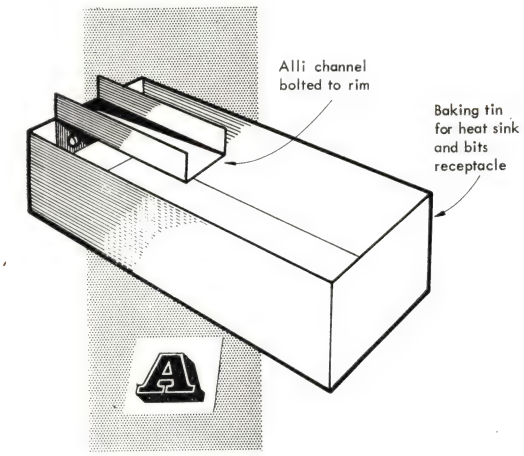
If you still have a valve type receiver the top end of the second bottom may be used instead of the lower part. This then gives sufficient additional room in the pack to accommodate a miniature D.C. convertor to provide H.T. in addition to the servo supply.

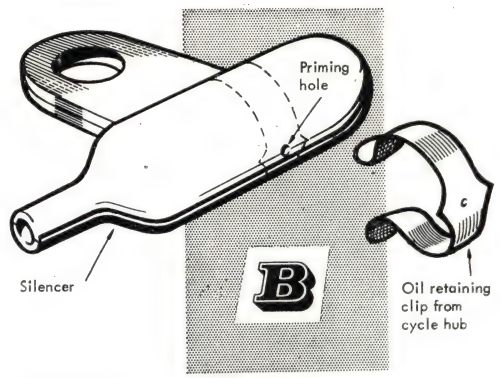
Boot Clips

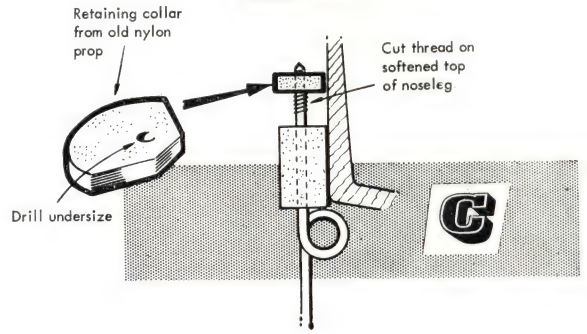
A thing, which until recently used to happen frequently to your editor, was that in the course of trips to and from the field; the tool box, fuel and even worse—the glow starter accumulator would spill all over the boot. No, not the editorial sandles! Although with the acid flying around, the car boot could very well become almost as openwork . . . Wedging things against tool box or battery never seemed to be the answer, so a strap of aluminium fixed with self-tap screws to the inside lining of the boot (make sure it isn't the outer skin!) ensures that the more spillable items do not tip over or charge about among the models, when cornering. Strong magnetic door catches might be an alternative method if you have no wish to drill the metal, or if it's someone else's car!

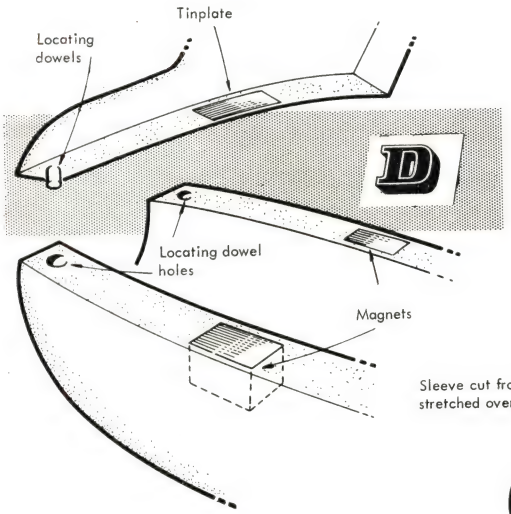
Quick Brake

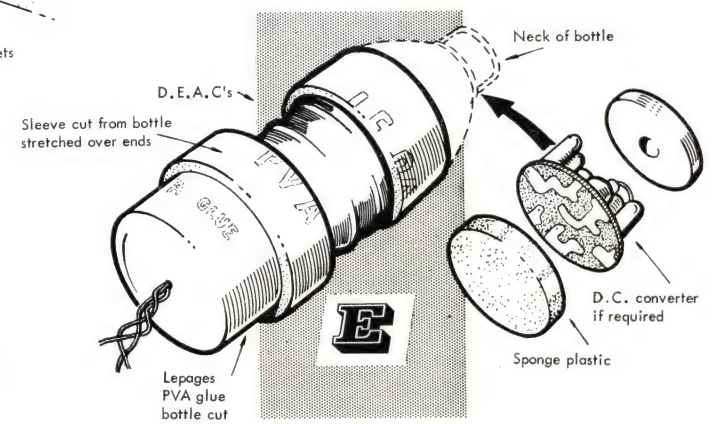
Here is a do-it-yourself version of the Air-Span brake which R. Charles suggests in two forms; one method is to put a 14 gauge wire peg in the wheel hub which, when the brakes are applied via a 16 gauge wire hook sliding in a brass tube, slams the brakes hard on. The second method is to have a spring loaded cork faced metal disc bearing against the hub, and carrying the 14 gauge stop pin. This time, the initial jolt is eliminated as the brake slips. The spring should be chosen to arrest the model smartly without burning the tyres.

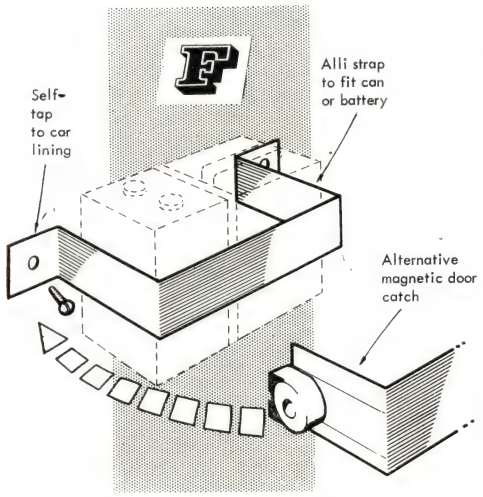

Alli channel bolted to rim
Baking tin for heat sink and bits receptacle
A

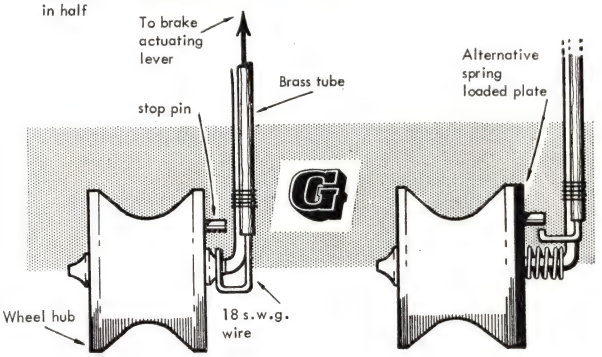

Priming hole
Silencer
B
Oil retaining clip from cycle hub

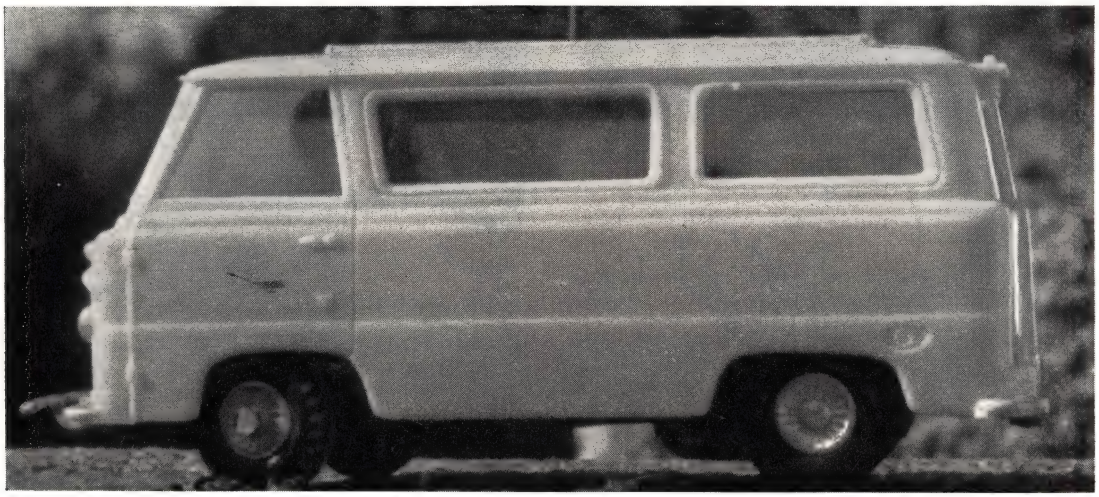

Retaining collar from old nylon prop
Cut thread on softened top of noseleg
Drill undersize
C


Tinplate
Locating dowels
D
Locating dowel holes
Magnets


Neck of bottle
D.E.A.C's
Sleeve cut from bottle stretched over ends
D.C. converter if required
Sponge plastic
Lepages PVA glue bottle cut in half
E


F
Self-tap to car lining
Alli strap to fit can or battery
Alternative magnetic door catch


To brake actuating lever
Brass tube
stop pin
Alternative spring loaded plate
G
Wheel hub
18 s.w.g. wire



A 'HONK'-KONG SPECIAL

SINGLE CHANNEL IN A MODEL MINIBUS—FOLLOW THESE SIMPLE INSTRUCTIONS AND FULL SIZE PLAN BY D. BOLLEN

THE everlasting problem of presents for the children forms rather a good excuse for habitual visits to local toyshops, where a bit of secretive browsing, among plastic oddities there, can often provide some inspiration to the modeller. Such was the case with the writer who, while waiting to be served, chanced upon a Thames Minibus of Hong Kong origin. The toy had a smart body-shell, a good set of wheels, and a fair amount of space inside, considering it had only a 4 in. wheelbase. The question was, could it be modified for radio control?

After getting it home, the Minibus was carefully dismembered with a sharp knife, incisions being made wherever surplus glue was in evidence. Casting aside the grotesque dolly passengers and their 'gear', also the moulding intended to represent seats and internal fitments, there was left a chassis with front wheel friction drive, a luggage rack which formed a useful lid giving access to the interior, a pair of rear doors, and the body-shell of coloured polystyrene, from which the chunky, transparent window moulding was removed. The chassis was almost symmetrical and, after some light work with a file, could be turned round so that drive was on the rear and the wheels corresponded with the body wheel arches.

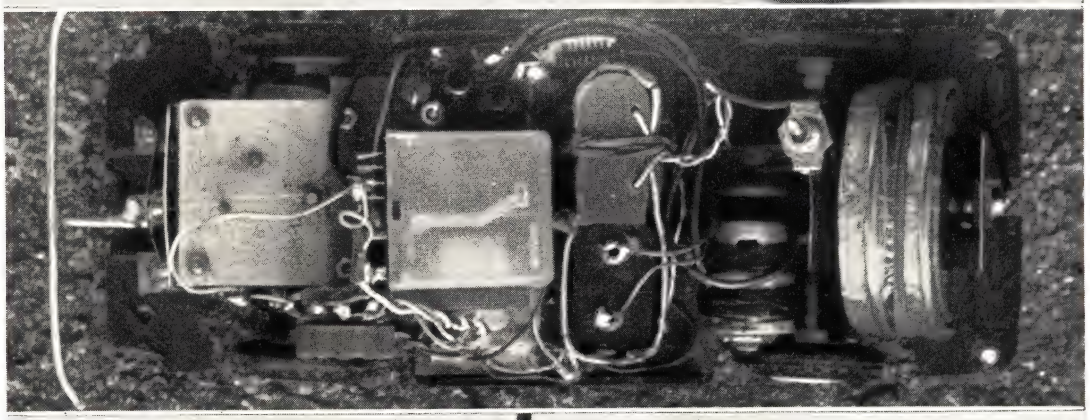
The rivets holding the drive unit to the chassis were removed with a drill. The friction motor was taken apart, by careful prising back the tin tabs, and its gear train inspected. All seemed to be in order with the exception of the axle gear, this was about to fall off and was restored to the manufacturer's original intention with a hot iron and solder. Distance pieces of plastic tubing were placed either side of the gear to stop sideways axle float. A quick scrabble in the junkbox brought to light a dimly remembered, dubious looking but small, electric motor. A $\frac{5}{8}$ in. diameter rubber wheel from a toy push-chair made a good fit on the shaft of the motor and, revolving speedily with battery connected, was made to bear lightly on the flywheel of the friction motor. The overall ratio seemed right for the job, and could be varied anyway by substituting a different size of rubber wheel later. A strip of springy brass, soldered to the case of the friction drive, served as a motor mount, as shown in Fig. 2.

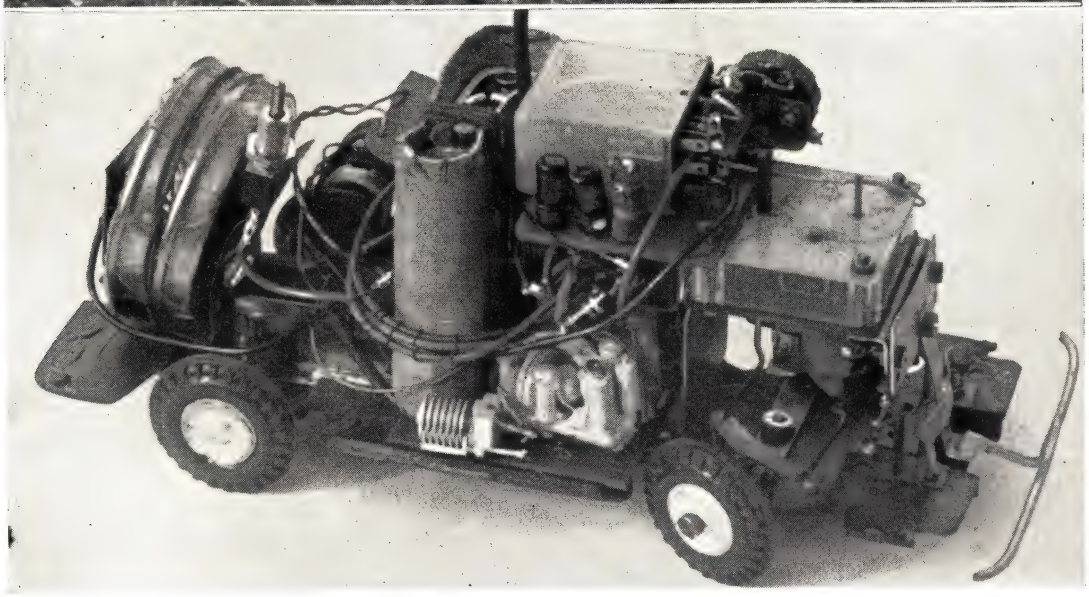
Soon the completed drive unit was bolted back in place, using 6 BA screws and nuts, and with a $4\frac{1}{2}$ volt flat battery amidships, the bare chassis could be seen charging across the living-room floor with plenty of wheel spin where the going was rough.

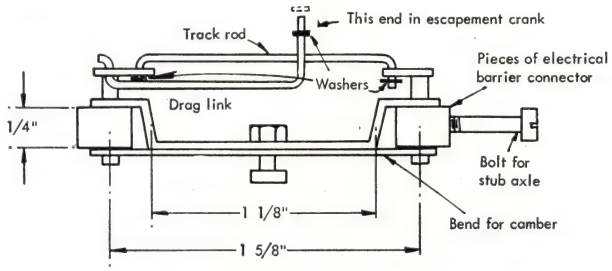
Steering was a big problem. Obviously, it would take some power to yank the wheels round when the model was carrying a payload of batteries and equipment. To minimise losses, some care was taken with steering geometry, and text books were consulted. The model did not like turning corners at all, nearly stalling in the attempt, despite correct wheel angles. It was, of course, the absence of a differential causing the trouble. One rear tyre was removed and lightly greased on the inside, and the hub was sandpapered so that the tyre would revolve freely on it. The model then circled with only a very slight reduction of speed. Details of front axle and steering linkage are given on the plan Fig. 1.

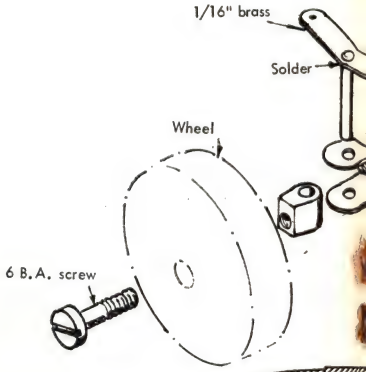
Catalogues revealed that commercial motorised

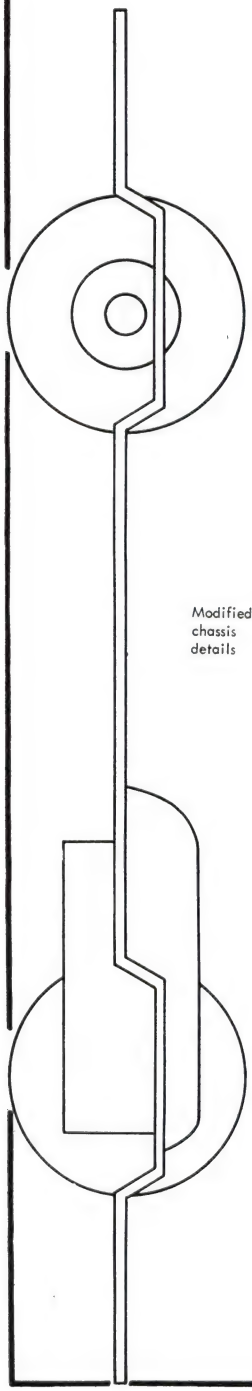
Heading photo shown about $\frac{1}{4}$ full size gives a fair indication of the amount of available space in the plastic body. Facing page; top photograph shows control pot next to actuator on the left and drive motor to right of battery pack, main DEACs at extreme right. Centre photograph is plan view shot showing reverse relay centre. Lower photograph, taken from the off side, shows the steering linkage, home-built receiver lower centre with reversing relay delay components above. On/off switch is next to DEACs.



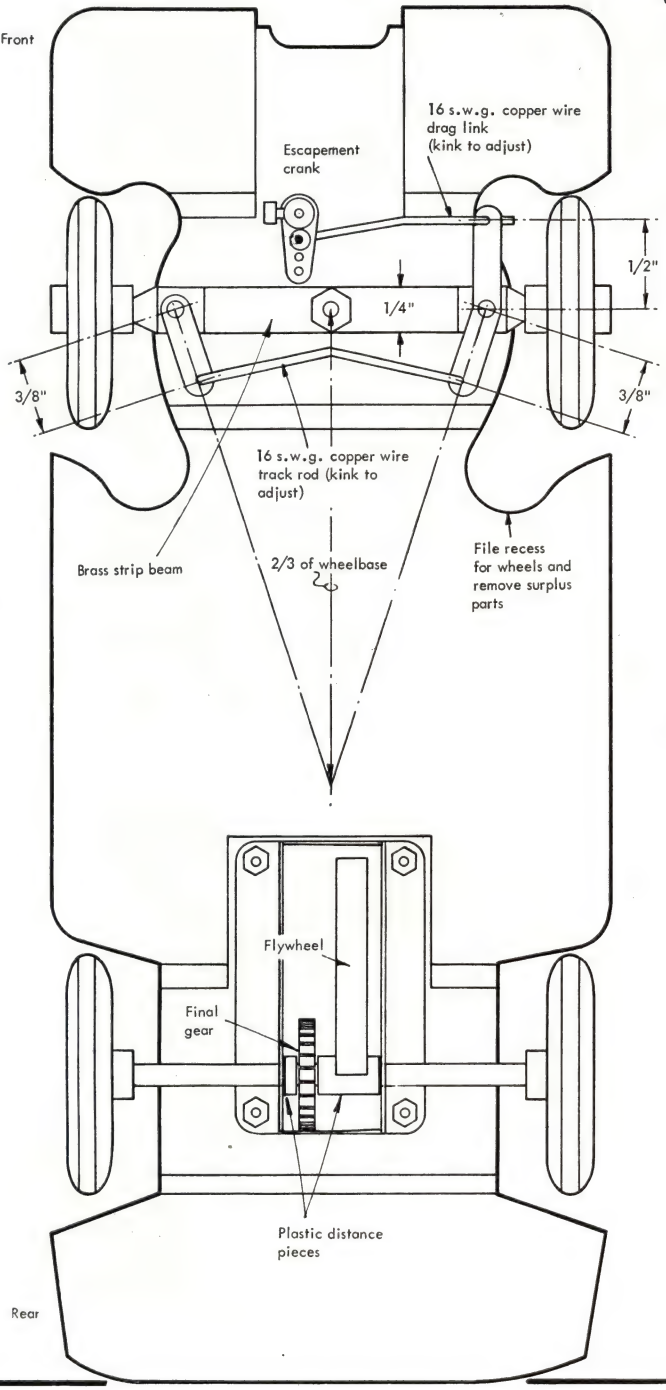


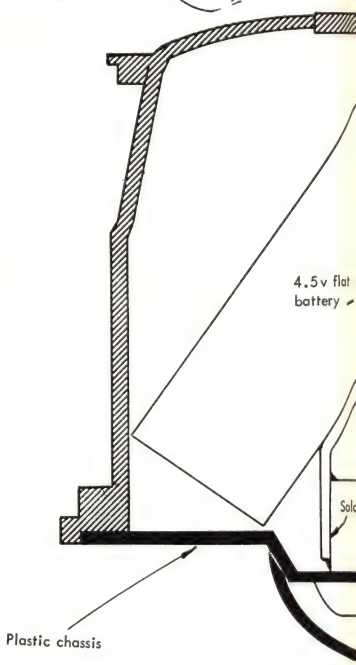


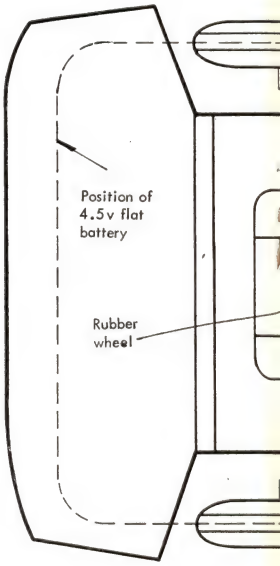




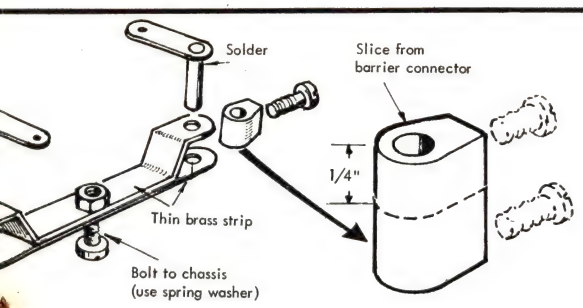
Modified chassis details

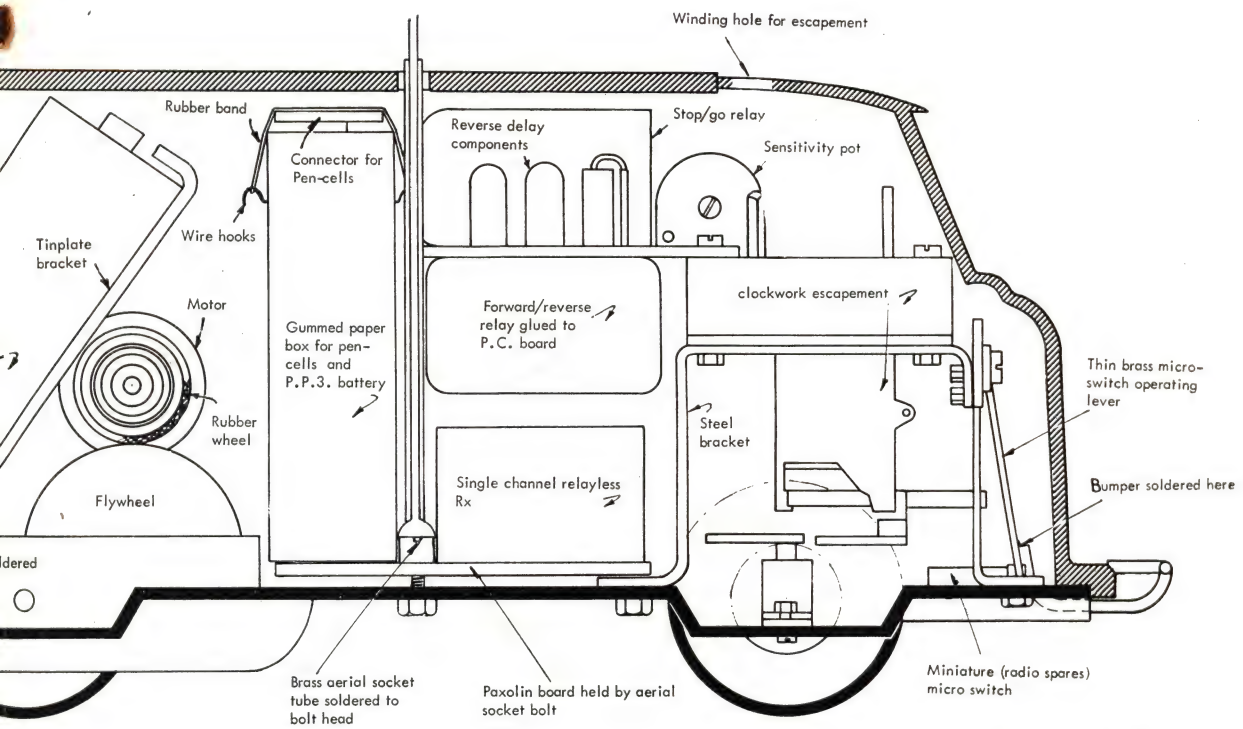


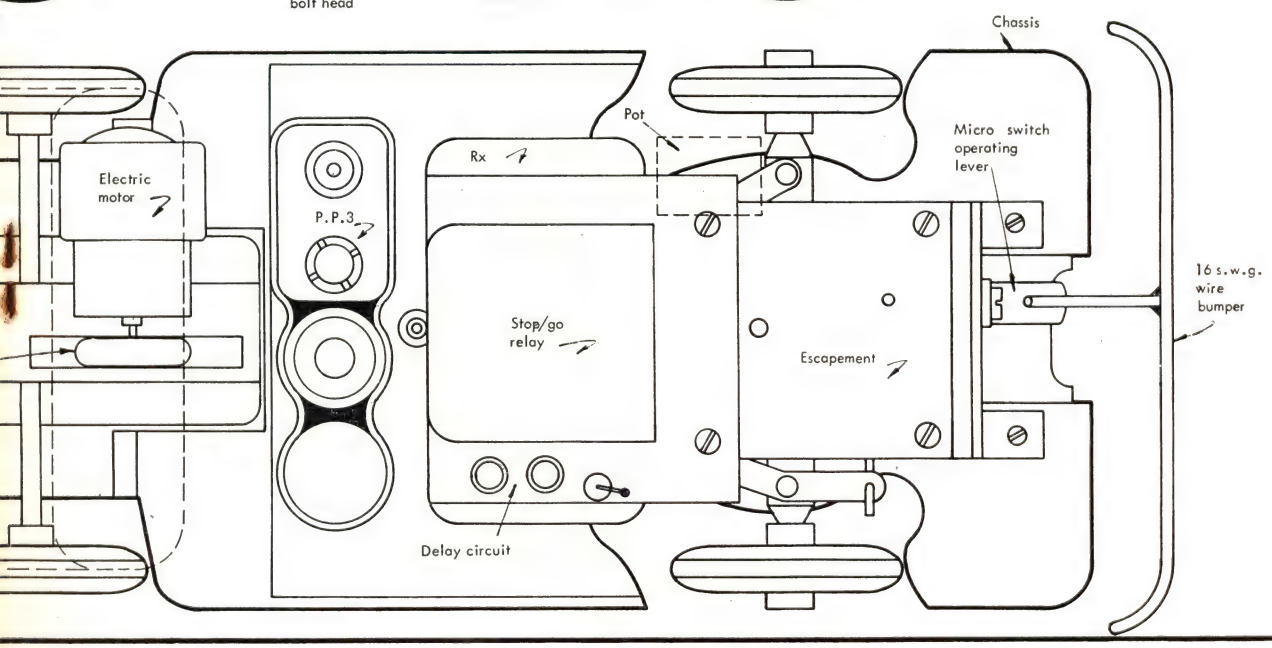




FULL SIZE PLAN SHOWING MODIFICATIONS TO PLASTIC MINIBUS AND COMPLETE RADIO INSTALLATION







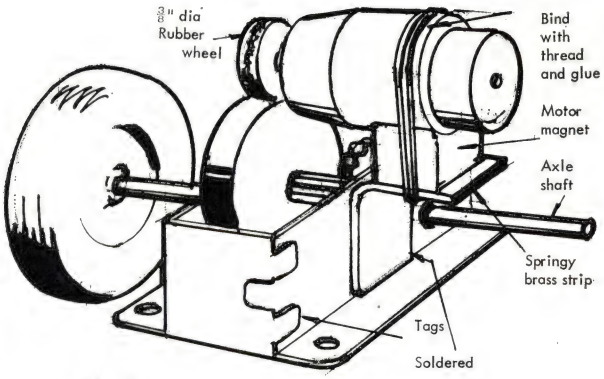
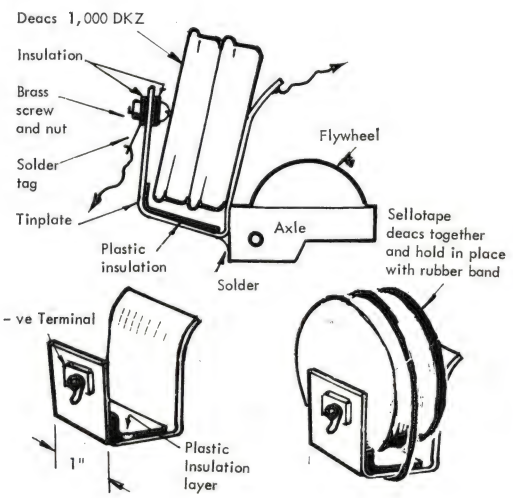


Fig. 2

servos were too big. A steering servo was painstakingly constructed, using a tiny gear train from an item of Ex-Government equipment, but in vain. It was virtually impossible to attain accurate centering, and the slightest deviation of the crank caused a decided turn to right or left. There things were left for a time until, risking it, an F. Rising clockwork four pawl escapement was purchased in the faint hope that it might produce enough power, under optimum conditions, to turn the steering. Early tests were unpromising, but the steering linkage was rather stiff. All holes were reamed with appropriate drills to make kingpins, tie-rod, and drag-link easy but not sloppy fits. This time the front-end worked well and precisely. Trials were carried out with thin flex wired to the escapement and a battery held in the hand, while the chassis careered around the floor. Results indicated a real need for "L" plates, but were deemed reasonable under the circumstances.

Next came the electronics, working in easy stages. Forget about forward and reverse, and all the niceties, concentrate for the moment on steering. No room for fancy equipment. Multi was out. Single channel, single button stuff only. A home-built superregen, smaller than a 3d. matchbox complete with dry-reed relay, seemed

Fig. 3



suitable. (A Modelectric "Minimod", MacGregor "Minimac" or Futaba F4–LR would also fit.) Soon the chassis, this time without wires attached, was clocking up the furlongs again on the living-room floor. Judging by its reaction, this was a new experience for the household cat, who had undoubtedly never seen anything like it before. One winding of the clockwork allowed tight figures of eight to be performed continuously for 15 to 20 minutes.

So far so good, but it was annoying when the learner driver could not avoid an obstacle in time and had to leave the transmitter to free the model. A wire bumper and a miniature microswitch operating a Super Alpha Pair delay circuit solved that one. It can be seen, in the circuit of Fig. 4, that when the microswitch contacts close the capacitor C1 is discharged and the transistors are driven hard on, thus closing the relay and reversing the connections to the motor. After the capacitor has re-charged slowly, via R2 and base of VT1, the relay switches back. With the component values shown, when the model hits anything it will reverse back for about 24 ins., allowing time for the steering to be turned to avoid the obstacle when the drive switches to forward again. With this simple addition, neat, realistic manoeuvres could be performed.

Whereas there is not much fun in turning the steering of a stationary model vehicle, it is sometimes desirable to be able to stop or slow down momentarily. Only a quick "blip" of the button was needed to steer, so hold down the button to stop. Apart from going out of range at the head of a flight of stairs, there is no real demand for a failsafe mode with this type of model. The addition of another relay, and a resistor to limit escapement consumption when held on, permitted the luxury of a pause for breath after negotiating a tricky chair-leg chicane, and further, the Minibus could be inched into position, driven into a garage, and reversed out.

After a lot of practice, with one button serving as steering wheel, brake, clutch, and gear lever, highly skilful feats of driving could be performed. Seldom was the model in such a position that direct human intervention was needed to get it out of difficulties. Occasional mishaps spoilt the illusion of having a Lilliputian driver aboard, such as a bit of fluff wound round an axle, and a peculiar drunken wobble caused by interference from the old drive motor. These were put right when the Minibus came in for its first 1,000 yards service. A separate battery of two pen cells was fitted alongside the receiver battery, in a shaped box made of several layers of gummed paper, to supply escapement and motor control circuits, thus diminishing interference by removing direct wired connection to the motor. A receiver sensitivity control pot was also added. The final layout is given in Fig. 1.

One lesson learned was that accessibility counts a great deal when it comes to the inevitable servicing. Such a small model is, it must be faced, very delicate, not the sort of thing a child would be allowed to play with. Receiver and battery box were mounted on one paxolin panel, held only by the aerial base screw. Delay and reverse circuits were on a separate panel, held by two nuts on the escapement. The whole lot could be removed in a matter of minutes. Adjustments to steering were carried out with long-nosed pliers, bending drag link or tie rod to alter the distance between centres. If, as happened when the cat finally pounced, the front axle is bent, slackening one nut and bolt in the middle of the axle and both stub axles can be undone, then the unit falls into its component parts.

Continued on page 84

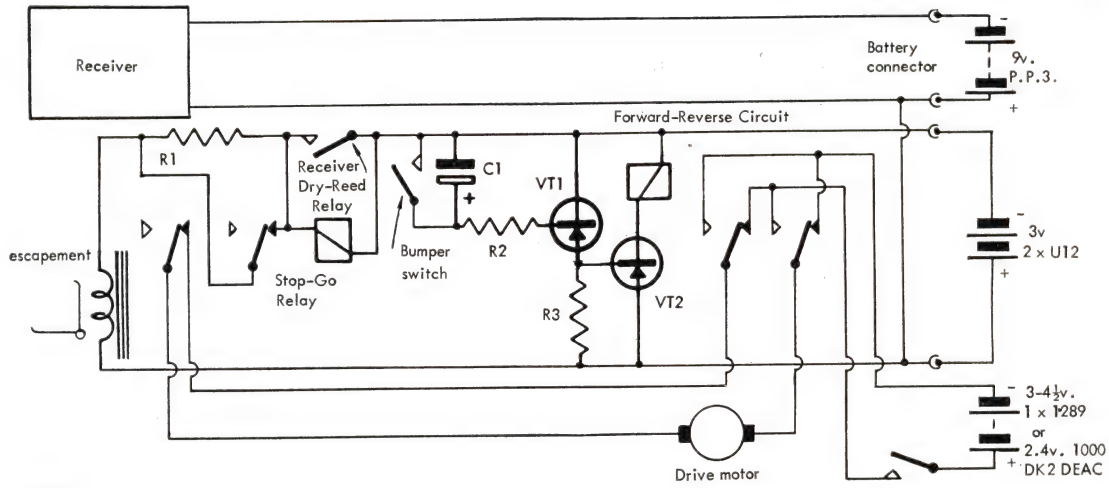
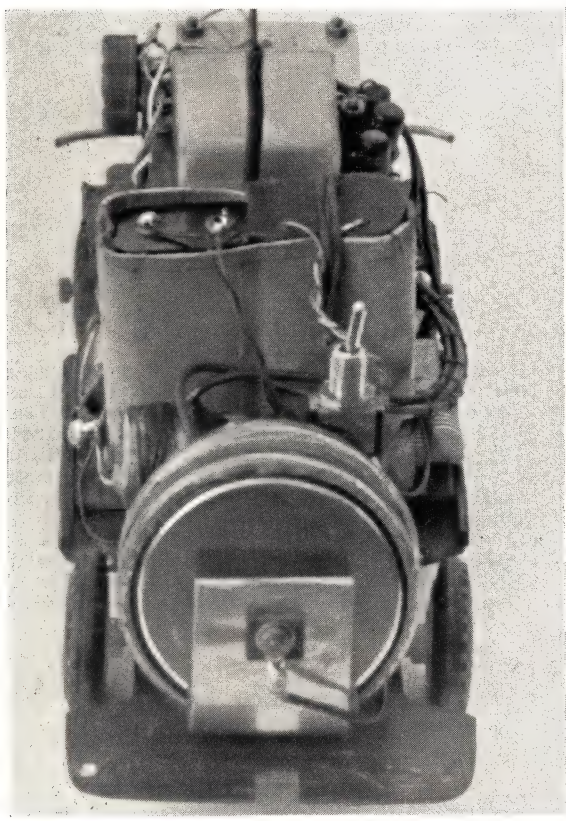


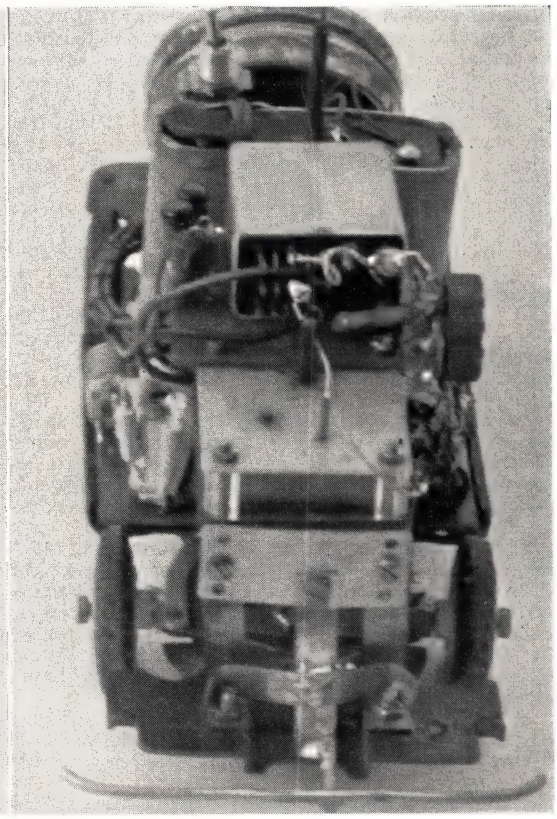
FIG. 4

COMPONENT VALUES

R1 : 16Ω
R2 : 100K
R3 : 10K
C1 : 10 μF electrolytic 6v. working.
VT1 : OC71
VT2 : OC71
Stop-go Relay : 130Ω coil.
Forward-Reverse relay : 130Ω coil.
Escapement : 8Ω coil.

Below left: rear view showing batteries and switch. Bumper switch and escapement showing clearly in front view right.





Control operating forces

R. H. WARRING EXPLAINS WHY A SERVO OR ACTUATOR HAS MORE WORK TO DO IN A FAST MODEL

THE force needed to move a control surface under flight conditions is quite different from that required to produce the same movement with the model static. In the latter case only frictional forces have to be overcome. In flight there is an added aerodynamic load or force which tends to blow the control surface back from its deflected position, the value of which will be proportional to the square of the airspeed. Friction should be negligible in a properly installed system—paying particular attention to achieving minimum hinge friction or stiffness as well as non-binding linkage. The difference between "flight" and "bench" performance is thus basically a matter of the aerodynamic load involved.

This is most conveniently expressed in the form of the *hinge moment* involved, which means the true force-moment needed to move the control surface to its deflected position and hold it there. Simply, this is the product of the actual force involved (F) and the effective length of the control horn (R)—assuming the conventional geometry of Fig. 1. Thus in this basic case, hinge moment = F × R.

In flight this is opposed by the aerodynamic moment produced by deflection of the control surface, in this case the product of the effective "lift" force (L) of the control surface in a direction at right angles to the airstream and the distance of the centre of pressure of the control surface having that angular displacement. In actual fact the displaced control surface will generate a resultant aerodynamic force trailing back from the perpendicular and the "drag" component as well as "lift" will also have a certain moment about the hinge point. This can be ignored. The fact that the centre of pressure of the aerodynamic "lift" force will vary with angle of displacement can also be ignored. Thus to simplify the matter we only need to consider a "lift" force which will vary with displacement angle and the square of the speed, considered acting at a constant centre of pressure point. Since virtually all control surfaces correspond to "flat plate" aerofoils in aerodynamic characteristics we can take the centre of pressure as acting at one quarter of the chord.

Full control movement thus implies a surplus of input hinge moment (F × R) over aerodynamic hinge moment (L × C), which is normally assured by any self-respecting actuator. The aerodynamic hinge moment can, however, build up rapidly with increasing speed, giving rise to troubles in flight. This is more usually noticeable on elevators than rudders; and also on motorised actuators rather than escapements.

In the case of an escapement the available (input) hinge moment is constant for any state of the escapement rubber motor, although it will progressively *decrease* as the motor becomes more and more unwound. Any measurement of available (input) hinge moment should

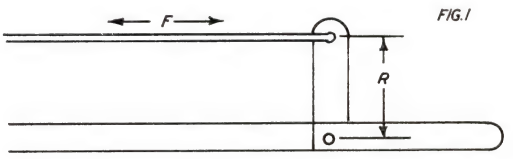


FIG.1

therefore be based on the escapement motor being *unwound* to that amount likely to be reached in flight. This is then the *minimum* "constant force" available, which can be measured directly as a "push" or "pull" force and calculated as the available hinge moment simply by multiplying by the effective length of the control horn (r)—Fig. 3.

If the aerodynamic hinge moment can exceed this then either the power of the escapement rubber must be

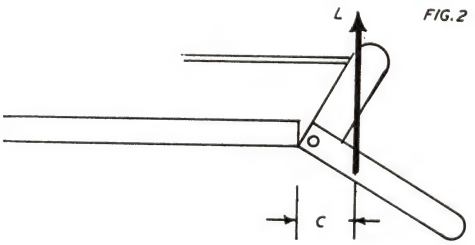


FIG.2

increased (which may mean a different escapement to cope) or an escapement may be considered inadequate to cope with that particular control duty required. There is, of course, also the possibility of increasing the available hinge moment by increasing the length of the control horn. However, this will affect the control movement available; and may not be acceptable as a solution. Equally, where alternative positions are provided on the control horn (equivalent to different deflections) the available hinge moment should be calculated on the basis of the smallest value of r likely to be used.

With a motorised actuator the question of available

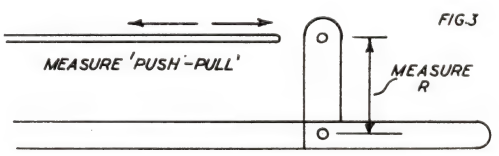


FIG.3

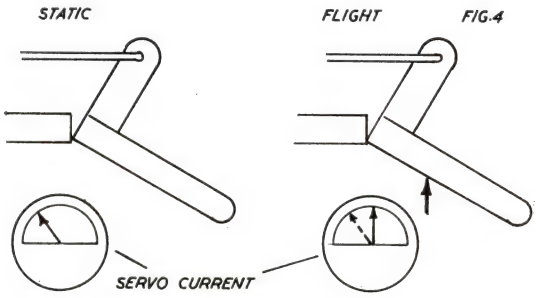


FIG.4

hinge moment is a little different. Under static conditions there is no aerodynamic hinge moment to be overcome so the servo motor is virtually working under "no load" conditions. When movement is opposed by aerodynamic load the servo motor will react by slowing down and drawing more current, under which running conditions it will generate more torque and thus more output force F. In other words, a *motorised* actuator is to a certain extent self-adjusting as the load against which it is working increases—at the expense of drawing more current and slowing down in movement—Fig. 4.

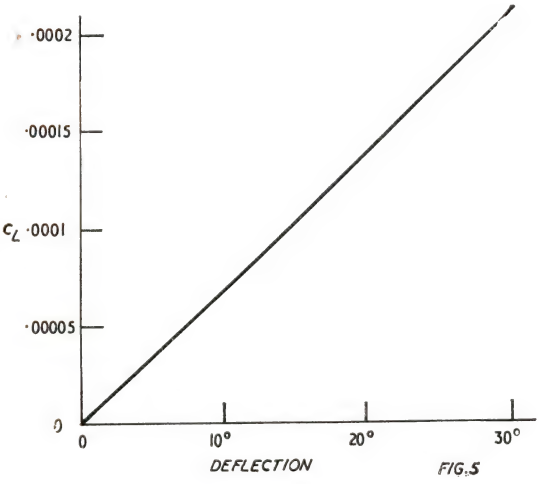


FIG.5

In practice the output force available from motorised actuators is usually sufficiently high for the current rise and slowing down effects to be negligible—for "bang-bang" control operation, at least. However, it will be appreciated that for *proportional* control movement the current rise effect will upset linearity of response. What will actually happen is that the control movement will be subjected to "blow back" and so to achieve proportional movement some system of feedback correction has to be incorporated. With simpler systems which do not rely on proportionality of movement—only movement to a limit—no trouble should be experienced unless the aerodynamic hinge moment exceeds the maximum available input hinge moment—as limited by the stall torque of the motor driving through the servo output gearing, or the maximum output torque of the motor as determined by a slipping clutch. In some cases, however, the current rise may be of an order such that the output of a relayless receiver cannot cope, when the combination may fail because there is a definite limiting current for operation of the servo, which sets the limit of the servo performance.

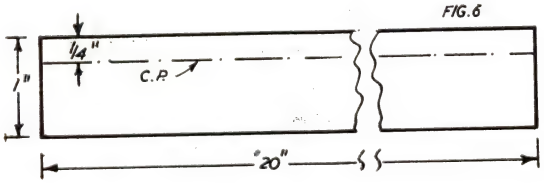


FIG.6

All such servo output forces, and the corresponding input hinge moments, are readily capable of measurement. The aerodynamic hinge moments against which they have to be balanced (or rather show an excess of input force) cannot readily be measured, although there is enough experimental data available to enable them to be estimated with a fair degree of reliability.

Experimental work necessary to relate theory to practice is concerned primarily with establishing empirical values for the equivalent "lift coefficient" of typical model control surfaces when deflected, from which it is then a simple matter to calculate the corresponding hinge moment. Such tests were undertaken by Dr. Walt Good of America some six years ago, using typical control surfaces and measuring the forces developed at different deflections at speeds of around 40 m.p.h.

These experimental data established that for all practical purposes the aerodynamic hinge moment was directly proportional to displacement angle of the control surface—which means, in effect, that the empirical factor involved (the lift coefficient) was directly proportional to deflection—see Fig. 5.

Having such data, it is then readily possible to calculate hinge moments for any size and shape of typical model control surface at any speed, provided we accept that "scale effect" is absent. This is a fair assumption since the original data were established with a typical mean size of control surface and typical mean speed (40 m.p.h.) in any case we cannot expect *exact* answers by calculation, but they should certainly be reasonably close to practical figures.

The basic formula for the "lift" force generated by any aerofoil is:

Lift $= C_L P_2 S V^2$

where C_L = a lift coefficient, variable with angle of attack (or angle of displacement in the case of a control surface)

P = mass air density = .0024 slugs per cu. ft.

S = surface area.

V—airspeed.

Conventionally, lift is expressed in pounds, surface area in square feet and speed in feet per second. Actual choice of units is purely a matter of convenience, however, and can be "adjusted" by changing the value of the dimensionless lift coefficient. The derived value of lift coefficient can also incorporate air density as an integral factor, further to simplify the equation.

We can thus rewrite the lift equation:

Lift in ounces $= C_{L1} \times S \times V^2$ . . . . formula A

where S = surface area in sq. inches;

V = airspeed in feet per second

or, Lift in ounces $= C_{L2} \times S \times V^2$ . . . formula B

where S = surface area in square inches

V = airspeed in miles per hour.

The corresponding values of C_{L_1} and C_{L_2} are summarised in the table. Provided the *right* value is used in each case (C_{L_1} used in formula A and C_{L_2} used in formula B), the answers will be the same—and correct.

The worked out values of lift coefficient (C_{L_1} and C_{L_2}) are based on these being directional proportional to angle of deflection to 30 degrees. This may seem unusual when a conventional aerofoil is expected to stall at about 10 degrees and markedly change its lift coefficient at this point, but appears justified from Dr. Good's results. Thus for a 14.3 sq. in. rudder at 40 m.p.h. he measured hinge moments of 2, 4 and 6 inch-ounces at 10, 20 and 30 degrees deflection, respectively.

Fig. 6. Normally it would only be necessary to calculate the hinge moment for a particular deflection (i.e. design maximum deflection), the main "unknown" being the flying speed. This again can be maximum estimate speed, or worked out for a number of different speeds. For the purpose of example we will work out the hinge moment for a fixed deflection (20 degrees) and a speed of 50 m.p.h. The second table gives worked out hinge moment values for three different deflections over a whole range of flying speeds.

Since we are working with speed in miles per hour, formula B applies. For 20 degrees deflection the corresponding value of C_{L_2} is. Surface area (S)=20×1= 20 sq. in.

Thus Lift= 0.000288 x 20 x 50 x 50
= 14.400 ounces

Since the chord of the control surface is 1 in. the effective centre of pressure will be at 25 per cent × 1 in. = .25 in. from the leading edge or hinge point.

Thus hinge moment=.25 × 14.400
=3.600 inch-ounces

LIFT COEFFICIENTS

Deflection	C_{L_1} *for use in Formula A*	C_{L_2} *for use in Formula B*
1°	·0000067	·0000144
2°	·0000134	·0000288
3°	·0000201	·0000432
4°	·0000268	·0000576
5°	·0000335	·000072
10°	·000067	·000144
15°	·0001005	·000216
20°	·000134	·000288
25°	·0001675	·000350
30°	·000201	·000432

HINGE MOMENT CALCULATIONS
20 in. × 1 in. Surface

Speed	*Deflection*		
	10°	20°	30°
20 m.p.h.	·288	·576	·864
25 m.p.h.	·450	·900	1·350
30 m.p.h.	·648	1·296	1·944
35 m.p.h.	·883	1·766	2·649
40 m.p.h.	1·152	2·304	3·456
50 m.p.h.	1·80	3·60	5·40
60 m.p.h.	2·60	5·20	7·80
70 m.p.h.	3·53	7·06	10·59
80 m.p.h.	4·62	9·24	13·86
90 m.p.h.	5·84	11·68	17·52
100 m.p.h.	7·20	14·40	21·60

'HONK' KONG SPECIAL

Continued from page 81

Range is far from spectacular with the minute 8 in. aerial, well in sight, in fact. However, only a small low-power transmitter was used for control, giving a maximum range of around 50 yards. The lack of suitable large scale surfaces for such small wheels, except perhaps for a very large dance hall, makes discussion of range strictly academic. The model was intended only as something to do at home when the weather made larger, more ambitious models less attractive.

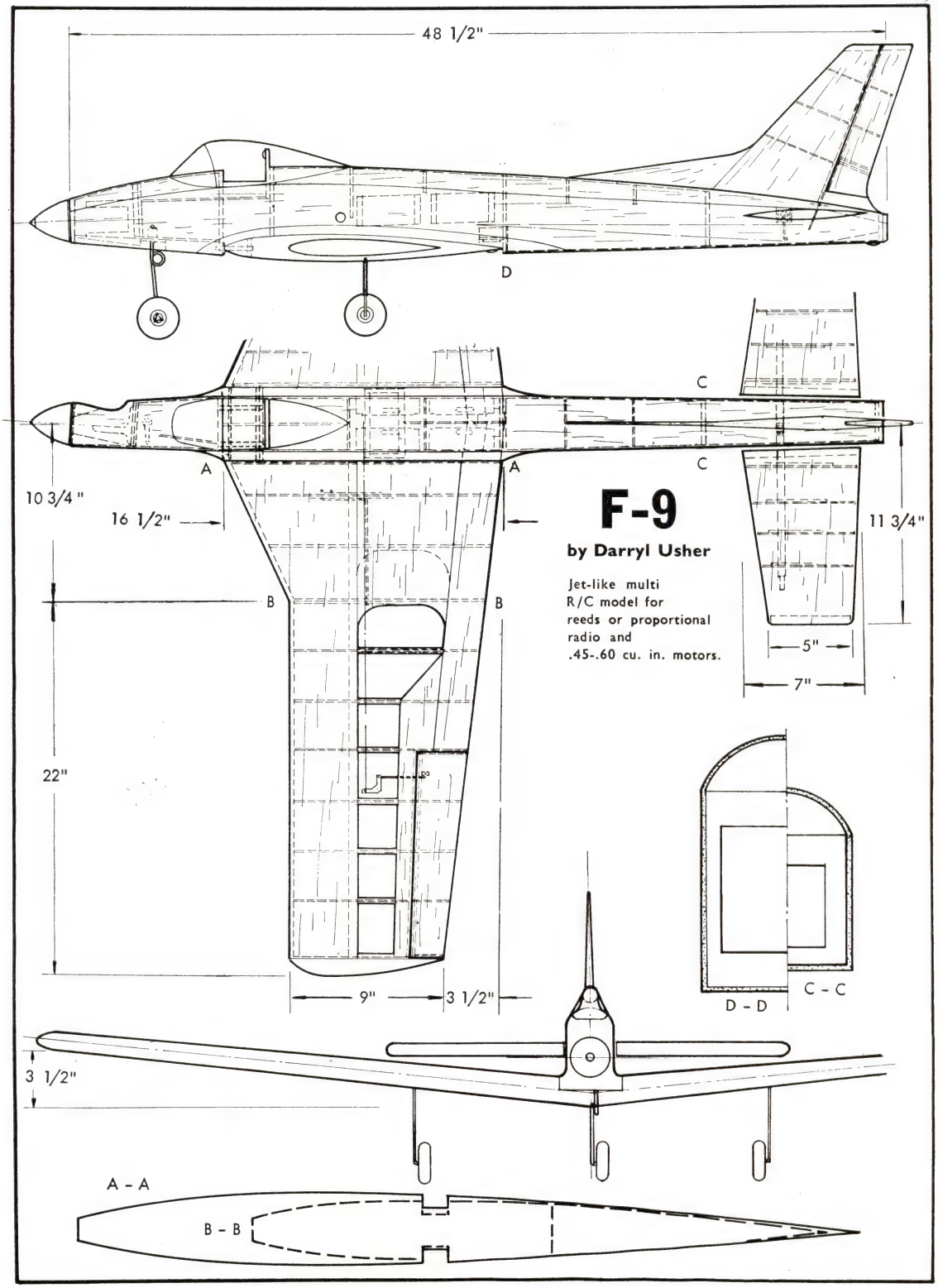
The 4½ volt drive battery gives a good turn of speed to begin with, but with a measured load of nearly 1 amp will not last for more than ½ hour at most. The running costs were most disproportionate to the size of vehicle, more than 3s. a mile. DEACs were therefore installed later, two 1,000 DKZ cells giving a range of at least 1 mile per charge, at a scale speed of about 28 m.p.h. The running costs are, with DEACs, negligible, if the initial outlay can be faced. The modified battery mount is shown in Fig. 3.

As a finishing touch, windows of translucent rather than transparent celluloid were fitted to obscure internal equipment while still giving a "see through" effect. The transparent luggage rack was divested of side rails and painted to match the body colour, to make an inconspicuous lid. The shell is retained on the chassis by the heads of two self tapping screws at the front and a brass clip at the back.

Model racing car enthusiasts will probably turn up their noses at the thought of an R/C Minibus, but manufactured equipment is still not small enough to be accommodated in the sleek shell of a 1/20th racer. Even so, try negotiating home furnishings at a scale speed of 100 m.p.h. No doubt other models may appeal. Despite an all up weight of 1 lb., the Minibus can climb surprisingly steep gradients, suggesting the possibility of very small model vehicles competing in organised trials and rallies where a laid-out course would be navigated and points awarded for driver's skill, range, speed, hill climbing ability, and adherence to scale. Undoubtedly, the "specials" encountered at such a meet would promote much interest and inspiration.

ARE YOU LICENSED?

Just in case newcomers to Radio Control are not aware of it—you need a licence for operating remote control equipment. No tests, just fill in a form and pay £1 for five years' cover. Application form and full particulars from Radio Branch, Radio & Accommodation Dept., G.P.O. Headquarters, London, E.C.1



From Radio Control Modeler magazine

Simple Installation Checking

for single channel models by E. O. TYLER

NO matter how simple a single channel system may be, the correct method of checking the equipment installed in a model should be followed. Basically you have to ascertain the following.

Battery voltage on load . . . current consumption of the receiver and actuator . . . correct functioning of the actuator independently of the receiver.

If a DEAC pack is installed in the model in place of dry batteries, then the charging socket would be needed to avoid extra connections in the harness. There are several methods of carrying out the aforementioned tests, but a system shown in figs. 1 and 2, suggested by E. O. Tyler seemed worthy of further development. Our final version of this system is illustrated in Fig. 3 and is suitable for a relayless Rx.

The basis of the installation is a Radiospares five pin plug and socket. Other types of plug and socket could be used, depending on either the size of the model or the size of the owner's pocket. The system illustrated is for a typical relayless system using common battery and a simple escapement. The test equipment required is a simple Multimeter or a converted government surplus Milliameter fitted with suitable resistors to enable it to read 0·500 mA and 0·5 volts.

Wiring Up

A harness is connected via the 5 pin socket as follows: Battery + left top, battery – right top. The receiver + to lower left, receiver and actuator – to lower right. Receiver output and remaining connections of actuator to centre pin of socket. All the leads should be doubled back and bound to the solder tags on the socket with thread after soldering.

Test Plugs

Plug "A" has two shorting wires to bridge the left pair of pins and the right pair, this is used as an on/off switch and is inserted to operate the equipment.

Plus "B" has the right hand pair of pins shorted and also bridges between the top left and centre pins. When inserted in the socket this plug supplies the actuator direct from the battery thus making it unnecessary to use the radio link when field checking. Fellow modellers will appreciate this point as no "air time" consumed in the process.

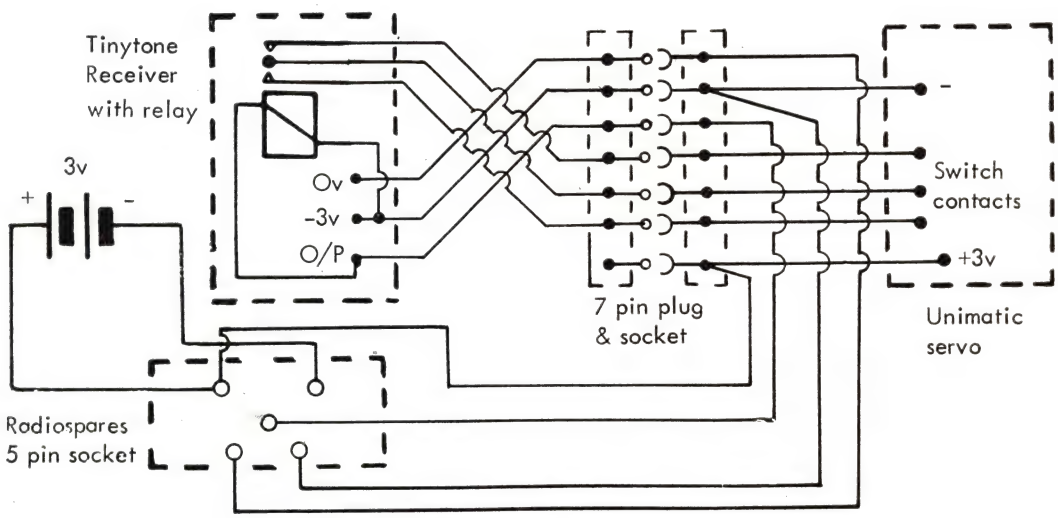
Plug "C" is used to test the output of the receiver to the actuator and at the same time measure the current consumption of the complete system. This plug shorts the left hand pins but connects the meter between the right hand pair of pins to read mA.

Plug "E" is used for voltage check on load, although if the meter when switched to read voltage has a pair of probes connected to it, either plug "A" may be used by touching the probes on the shorting wires if exposed or, without the receiver in the circuit on the shorting wires of plug "B". The actuator then supplies the load without the need to transmit a signal. Otherwise, plug "E" is the same as plug "A" but has leads for meter connection.

Plug "D" has one lead to each of the upper pins and is connected to a charger. This plug is only used when DEACs supply the system in the model.

This system of testing is not limited to relayless

Fig. 1



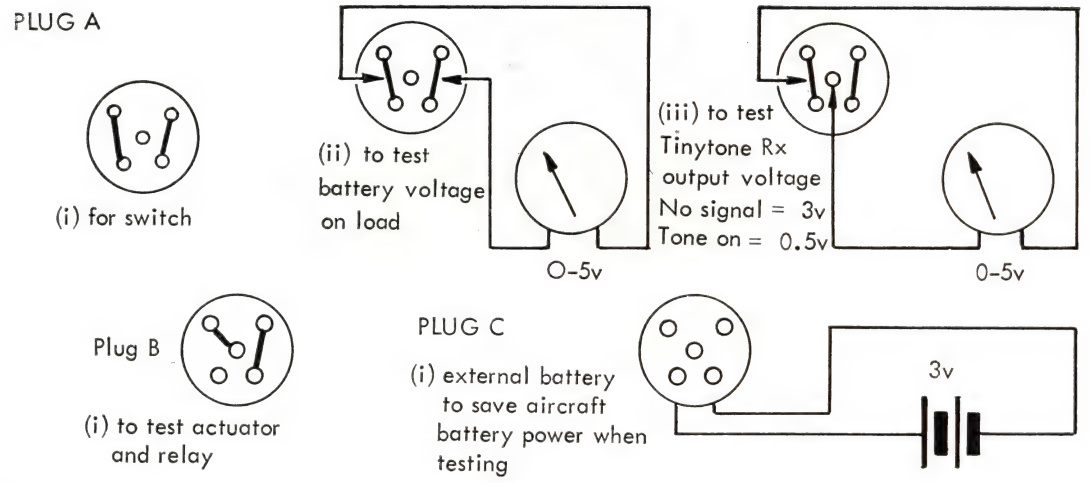


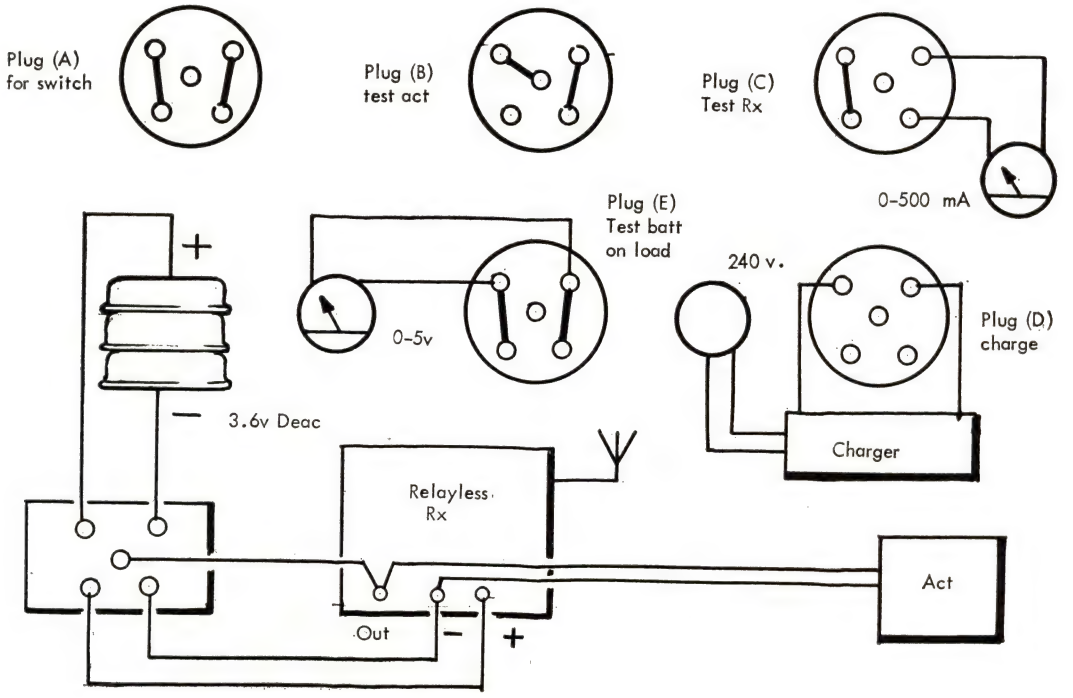
FIG. 2

outfits, for example B7G plugs and sockets may be used to suit relay receivers and motorised actuators which do not employ an external relay (unlike the C/L Developments "Unipack" combined rudder and throttle system).

Avoid carrying things too far . . . the more plugs and sockets you have, the more there is to go wrong. The simple system described earlier relies on only 4 contacts and plugs and sockets using this limited manner are recognised by many modellers as being superior to switches, on the grounds that they can be examined readily for cleanness, contact is generally tighter than that on a switch and is less likely to be affected by engine vibration.

Give this checking system a try . . . It is far better to spend a few minutes between flights making quite sure everything works than to try and trace a fault by cutting wires here and there and certainly more convenient to carry out an actuator test without interference with other receivers or from other transmitters.

FIG. 3

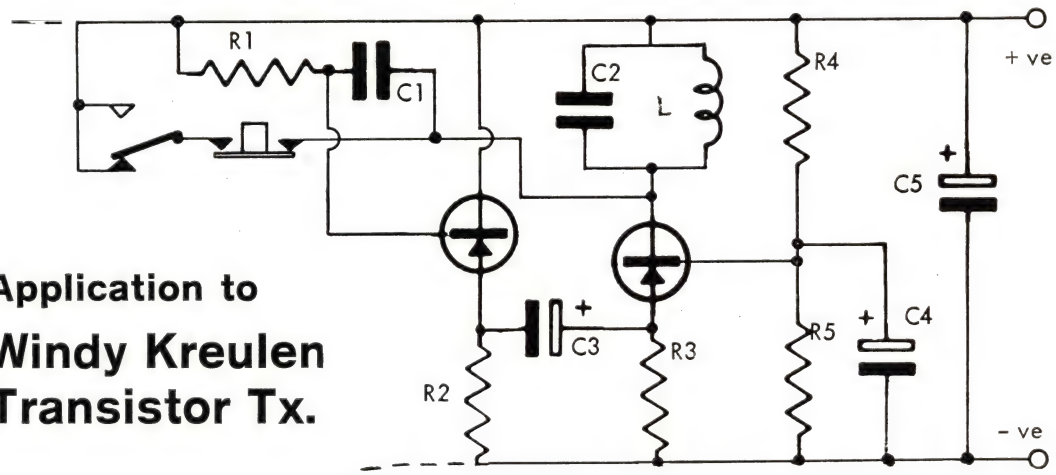


'QUICKER BLIPPERY'

R. G. MOORE describes his foolproof quick blip switch

SOME tone transmitters, for example the R.C.S. Guidance system, have a normally closed keying switch A useful quick-blip keying device could be added to such circuits. There is nothing electronically complicated about this system. Take a slide switch or toggle switch of the single pole changeover type, bridge the two outer contacts and take them to one of the existing keying button leads which have been removed from the key, this tag on the key now goes to the centre contact of the new switch. It will be noticed that when the changeover switch is operated, the circuit is broken for a fraction of a second as the contact snaps over from one side to the other. Toggle switches give the best results as the speed of changeover is fairly consistent. A double pole changeover switch may be used for extra safety. This time, all four outer contacts are wired together and the centre two paired from the other connection. This system has worked well with the Reptone and Windy Kreulen multi Tx which was also used in single channel mode.

It will be noticed from the circuits in figs. 1 and 3 that the circuit mods allow a normally closed mode of switching to be used to key the tone generator. It should be simple enough to wire the keying and quick-blip switch as indicated, in place of the normal circuitry.



Detail of Quick Blip switch

N.C. keying button

Additional switch S.P.C.O.

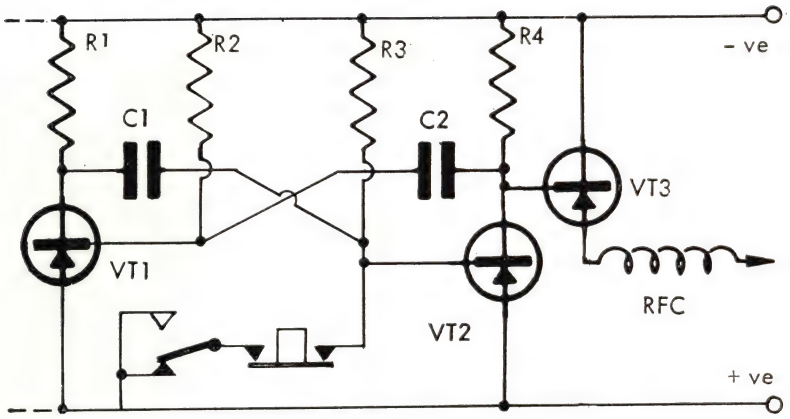
COMPONENT VALUES

R1	:	470K
R2	:	4.7K
R3	:	27K
R4	:	6.8K
R5	:	4.7K
C1	:	.1 μF
C2	:	.1 μF
C3	:	2 μF electrolytic
C4	:	50 μF electrolytic
C5	:	50 μF electrolytic

Application to Easytran Tx.

COMPONENT VALUES

R1	:	6.8K
R2	:	47K
R3	:	47K
R4	:	2K
C1	:	.04 μF
C2	:	.04 μF
VT1	:	OC83
VT2	:	OC83
VT3	:	OC83
R.C.F.	:	Macpack Type



Hovercraft, for R/C

Continued from page 65

one for propulsion, and the forward one for steering in the manner shown in Fig. 6, arrangement of a flap being provided to direct the steering "blow" at either 330° or 310°, and also 30° downwards. It has been shown however, that even a small electric motor has sufficient power to provide propulsion and steering in a fairly light-weight model.

Limited facilities prevent the author from further experimentation, but this article should give food for thought to designers. It may be interesting to note that the final shape for my proposed "ideal" model is very similar to SRN-2—perhaps a good basis for a scale model . . . ?

FIG.5A

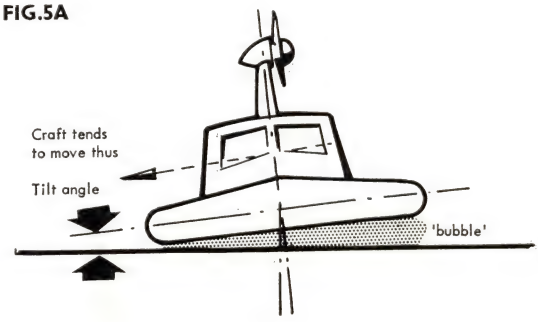
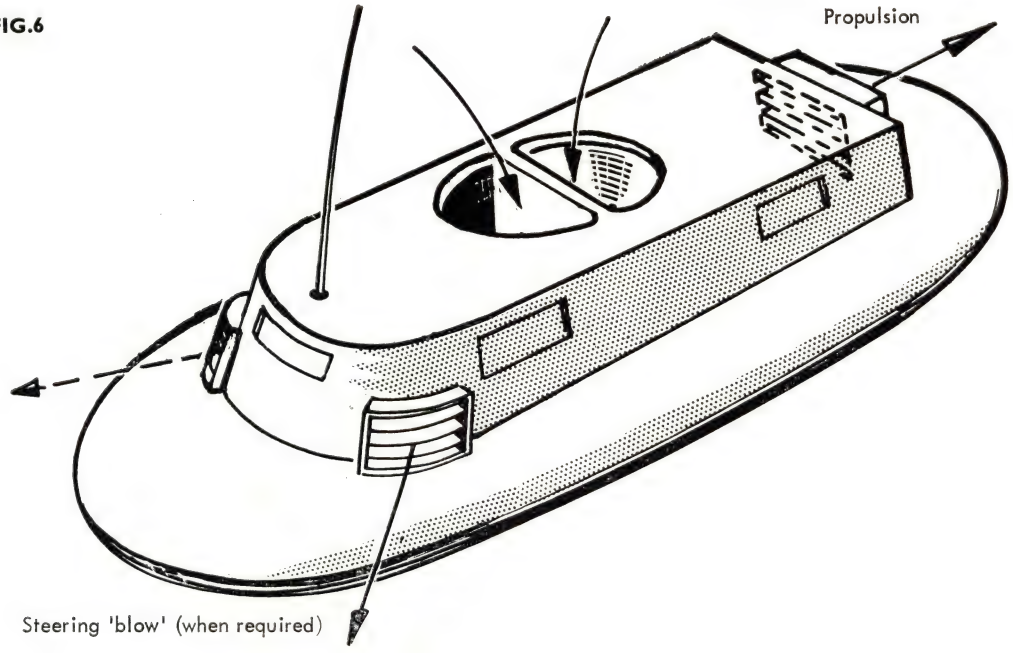


FIG.6



R.C.M. & E. Test Report

EDITORIAL REVIEW & TEST

● Raven Electronics 10 Channel Tx, Superhet Rx. and Super-regen Rx.

WE are always interested to see new manufacturers, particularly British manufacturers, in the radio control field. Raven Electronics showed prototype equipment at the 1965 British Nationals. Whilst the electronic development has, we understand, since that time undergone no significant change, the presentation of the cases and production methods have now just been finalised.

From the start, the designers intended that the equipment would be a rival to the well established imported equipment. Without making any direct comparison, it would appear that a great deal of care and thought has gone into this new equipment. Certainly this presentation of the equipment shows very well. The initial trial batches of equipment were in coloured anodising on aluminium, two piece folded cases for the multi equipment and Hammertone paint finishes on the single channel equipment.

The cases are now to be produced in high gloss black anodised aluminium. We saw a sample of a new case which gives the final quality touch to a piece of advanced electronic production.

Further examination of the equipment shows that a high standard of workmanship is apparent in the construction of the circuit board and the choice of components indicates that nothing has been left to chance in respect of stability and safety. It will be noticed from the test figures that the current consumption of the transmitter is quite high. One cannot have high output otherwise and the apparent radiated power of both multi and single transmitters should be adequate to reduce the chances of distant interference quite effectively.

The Tx. employs 7 slicon epitaxial plana transistors. The P.A. stage uses a single high voltage transistor which is allowed to pass almost double the power when tone is transmitted.

The tone oscillators use vacuum impregnated ferrite core transformers and voltage is Zenner stabilised.

Transmitter Physical Data

Size

8 in. high x 6¼ in. wide x 3½ in. deep + ¾ in. lever projection.

Aerial

Chrome plated telescopic 10 section 41 in. long, retracted ¾ in.

Weight

2 lb. 9 oz. plus 17 oz. with two VT1 or PP1 batteries.

Keying switch travel

$\frac{1}{16}$ in. each side of neutral to make $\frac{3}{16}$ in. total travel each side of neutral.

Pressure required to make: 2.25 oz. Total pressure for full travel: 9 oz.

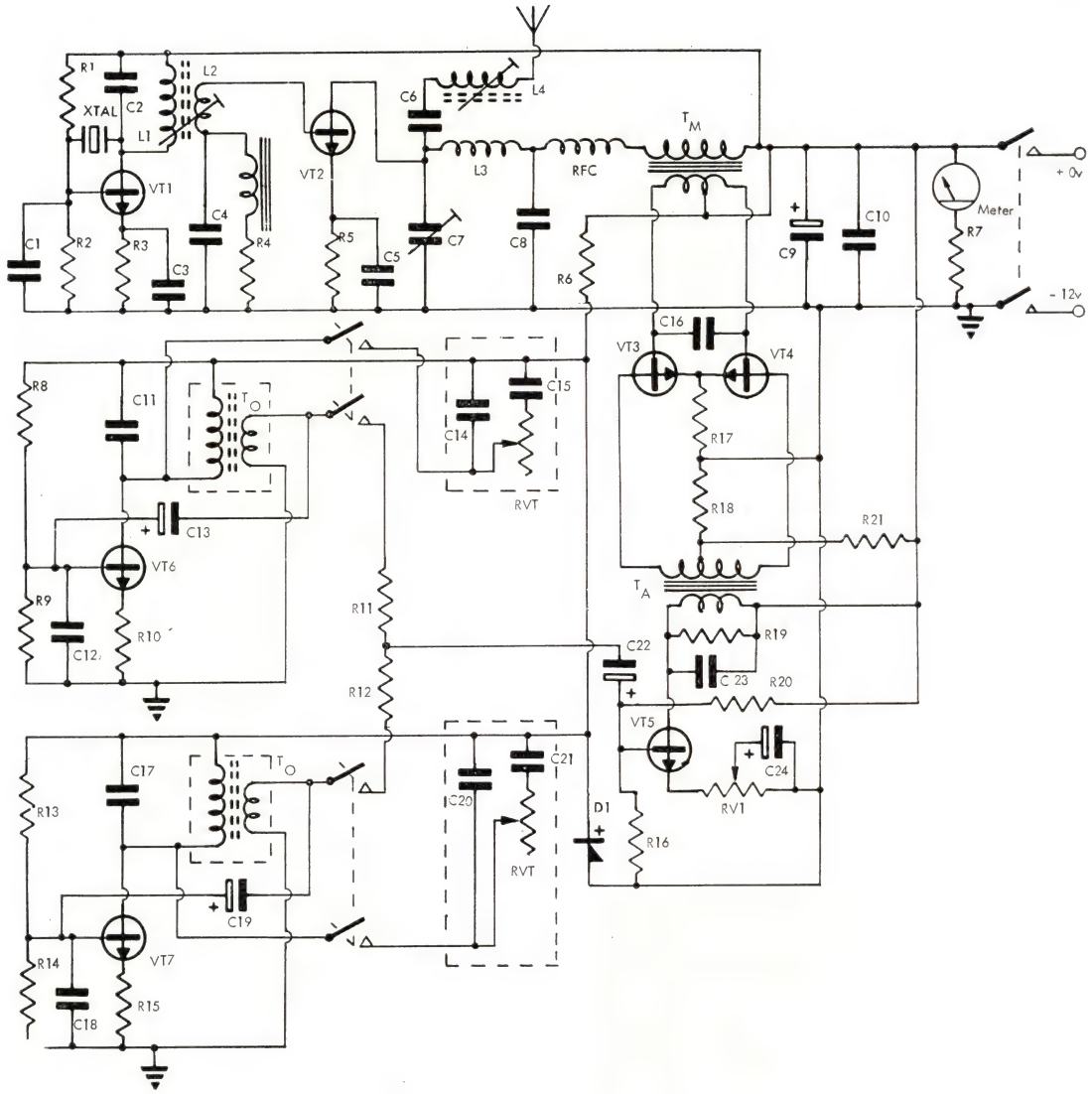
Materials

Case; 18 s.w.g. hard aluminium polished and anodised black. The circuit board $\frac{3}{32}$ in. glass epoxy laminate mounted with the copper side towards the front of the case. Lands are rectangular, maximum copper system and components placed neatly in a horizontal layout. Sealed type tone adjustment pots are used and are positioned appropriately to the control keys, although not identified on the board. The land side of the board is coated with anti-humidity varnish and the Bulgin lever switches are mounted directly to the front of the case with flying lead connections to the p.c. board.

A battery state meter of the edgewise type is incorporated in the front panel, the red mark thereon indicating voltage of approximately 8 volts; the figure at which the 12 volt supply should be changed.

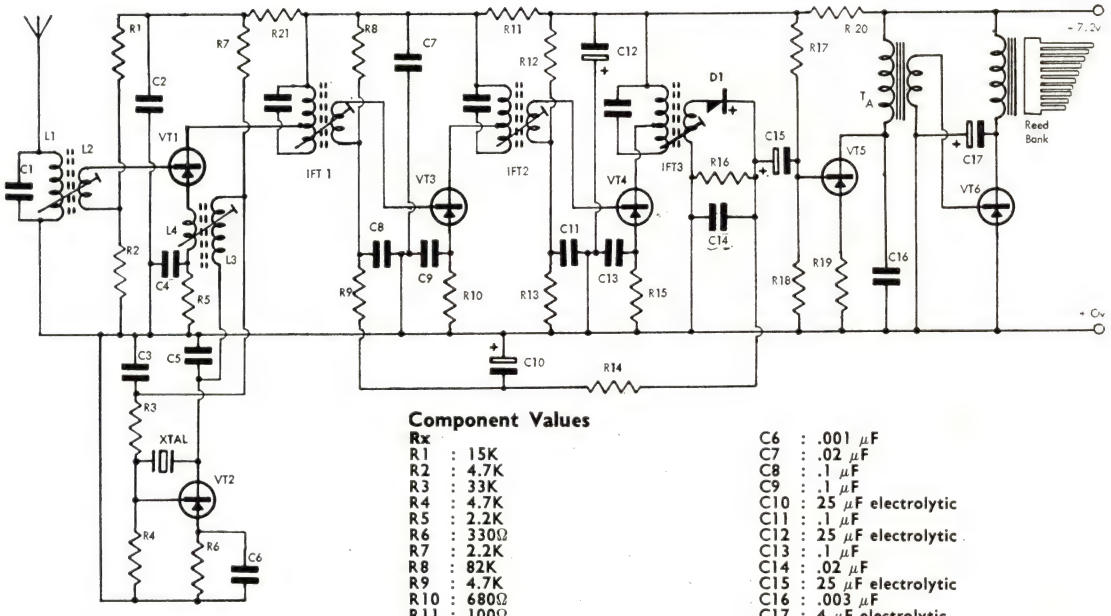
The makers recommend a DEAC 500 DKZ pack although the 12v. supply from 2 VT1 or PP1 batteries is considered adequate for normal operation. The DEACs will supply sufficient current for 3 hours continuous operation on carrier and two hours on continuous **tone.** No charging socket has been provided in the standard transmitter so it is presumed that the majority of users will install dry batteries.

The aerial is led through a large shrouded grommet in the top of the case, which also serves as a waterproofing device. The lower end of the aerial screws into a polypropylene block behind, and fixed to, the front face of the case. Foam plastic pads prevent movement of the batteries. A double pole on/off switch braks both battery connections so that those users fitting DEAC cells, have the battery completely isolated when in the "off" position.



RAVEN ELECTRONICS 10 CHANNEL TX. CIRCUIT VALUES

R1 : 10K
R2 : 1K
R3 : 100Ω
R4 : 100Ω
R5 : 10Ω
R6 : 150Ω
R7 : 39K
R8 : 15K
R9 : 5.6K
R10 : 100Ω
R11 : 1K
R12 : 1K
R13 : 15K
R14 : 5.6K
R15 : 100Ω
R16 : 2.7K
R17 : 4.7Ω
R18 : 100Ω
R19 : 4.7K
R20 : 4.7K
R21 : 2.2K
C1 : 30pf
C2 : 15 pf.
C3 : .001 μF
C4 : .001 μF
C5 : .001 μF
C6 : .001 μF
C7 : 3.30 pf
C8 : .001 μF
C9 : 125 μF electrolytic.
C10 : .001 μF
C11 : To suit tone
C12 : .001 μF
C13 : 10 μF electrolytic.
C14 : To suit tone
C15 : To suit tone
C16 : .22 μF
C17 : To suit tone
C18 : .001 μF
C19 : 10 μF electrolytic.
C20 : To suit tone
C21 : To suit tone
C22 : 10 μF electrolytic.
C23 : .047 μF
C24 : 10 μf
D1 : Zenner Diode
VT1 : R.E.1
VT2 : R.E.2
VT3 : R.E.1
VT4 : R.E.1
VT5 : R.E.3
VT6 : R.E.3
VT7 : R.E.3
L1 : 18 turns 28 s.w.g., e.c.w.
L2 : 3 turns 28 s.w.g., e.c.w.
L3 : 10 turns 16 s.w.g., e.c.w.
L4 : 9 turns 22 s.w.g. e.c.w.
RFC : 25 mH
RVT : To suit tone
RV1 : 1K variable
TO : Raven Electronics
TM : Raven Electronics
TA : Raven Electronics

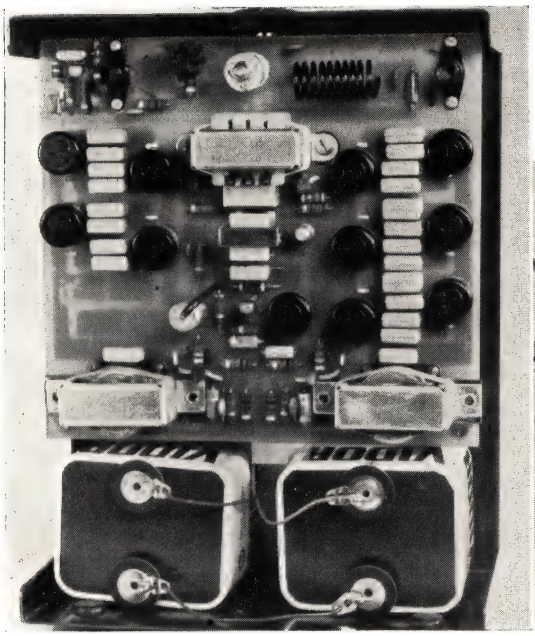


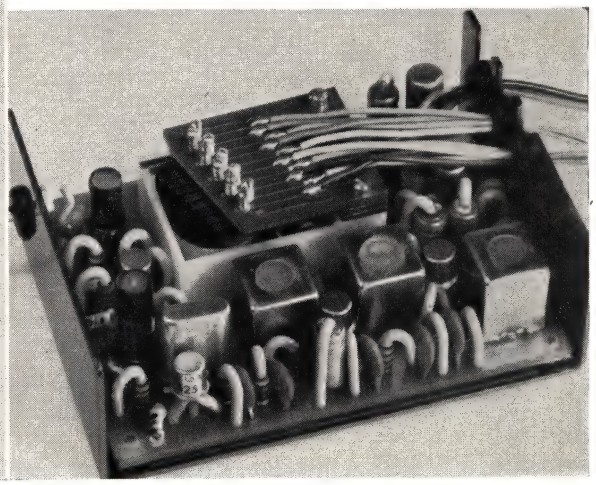
RAVEN ELECTRONICS 10 CHANNEL RECEIVER CIRCUIT

Component Values

Rx

R1	:	15K
R2	:	4.7K
R3	:	33K
R4	:	4.7K
R5	:	2.2K
R6	:	330Ω
R7	:	2.2K
R8	:	82K
R9	:	4.7K
R10	:	680Ω
R11	:	100Ω
R12	:	18K
R13	:	4.7K
R14	:	3.3K
R15	:	220Ω
R16	:	2.2K
R17	:	47K
R18	:	2.2K
R19	:	220Ω
R20	:	220Ω
R21	:	220Ω
C1	:	30 pf
C2	:	.02 μF
C3	:	.02 μF
C4	:	.001 μF
C5	:	22pf
C6	:	.001 μF
C7	:	.02 μF
C8	:	.1 μF
C9	:	.1 μF
C10	:	25 μF electrolytic
C11	:	.1 μF
C12	:	25 μF electrolytic
C13	:	.1 μF
C14	:	.02 μF
C15	:	25 μF electrolytic
C16	:	.003 μF
C17	:	4 μF electrolytic
D1	:	OA90
VT1	:	2G415
VT2	:	2G415
VT3	:	2G415
VT4	:	2G415
VT5	:	2G301
VT6	:	2G382
L1	:	15T 28 s.w.g. e.c.w.
L2	:	3T 28 s.w.g. e.c.w.
L3	:	18 T 28 s.w.g. e.c.w.
L4	:	1T 28 s.w.g. e.c.w.
TA	:	Ardente D1001
Reed Bank	:	40Ω Deans 10
IFT's:		To Raven specifications





Left: Rear shot of the transmitter with back removed shows the three special Raven transformers and neat grouping of components. The crystal is soldered in. This also applies to the super-het shown below . . . like a number of other outfits not so convenient for changing from spot to spot. The Rx neatly laid out and exposed components leads sleeved. These constructional remarks also apply to the Super-regen version illustrated opposite.

Test Figures

Currents

The test was conducted with two 6v. dry batteries in series (VT1 or PP1 types). Aerial up, carrier 82 mA.

tone 96 mA (bi-simultaneous)
tone 100 mA (one tone)

Aerial retracted, carrier 110 mA.

tone 112.5 (bi-simultaneous)
tone 113 mA (one tone)

Waveform

The waveform is a chopped sine, and the display shows an increase of envelope of 50 per cent over carrier level on either single or bi-simultaneous tone operation.

Voltage Stability

The batteries were allowed to run down to 8v. with no loss of reed response in the receiver. It was first not necessary to adjust the tone frequency pots during this experiment. When voltage fell below 8v., tone was not continuous so it may be concluded that this voltage figure represents a minimum working level to be tolerated.

Estimated Output

The most noticeable feature of the transmitter is the increase in the output with tone. This does not necessarily show up on a field strength meter, as it will be appreciated that modulation reduces the duration of a signal, even though the amplitude may be increased.

Temperature Stability

This will be dealt with under the complete equipment test.

Superhet Rx.

The superhet receiver, at first sight, seems to contain fewer than normal number of components, however, these are particularly small and the layout is not cramped. The 18 s.w.g. aluminium case chassis seems adequately strong and the circuit is built on a $\frac{3}{32}$ in. glass epoxy board. There is provision for further connections to suit the power input cables for a complete set of 5 Bonner Transmitter type servos. As supplied, the superhet has a Deans reed-bank with colour coded pairs of cables for the bias connections of each servo. The tones are arranged so that each third reed operates the same servo. In other words should two adjacent reeds operate together then the relayless servo, if of the older type, is less likely to be damaged.

The six transistor circuit has three I.F. transformers and the aerial and oscillator coils are both sealed with wax in addition to the I.F. adjustment slugs.

Physical Data

Size

Length $2\frac{7}{8}$ in.
Width $2\frac{1}{8}$ in.
Depth 1 in.

Weight

3.45 oz.

Harness length: 10 in. comprising two sets 5 pairs colour coded bias wires for servo connections, one set three (pos. neg. and separate reed bank comb bias connection).

Aerial: 30 in. long (no colour coding reference as to spot frequency).

Case material 18 s.w.g. hard aluminium chassis, 20 s.w.g. aluminium cover. Both anodised high gloss black with white silk screen legend. Receiver board secured with 4 P.K. screws at corners, no spacers, insulating plate between lands and case. There is $\frac{1}{8}$ in. clearance between top of reed contact screws

and case, approximately $\frac{5}{16}$ in. clearance between other components and top of case to allow case to "give" without damaging components in the event of a severe crash. Underside of p.c. board coated with anti-humidity varnish.

Test Figures

Currents

Common 7.2v. input from DEAC pack.
No signal 7 mA.
Carrier 6 mA.
Tone 70 mA.

A.F. Range

Lowest tone 350 c.p.s.
380 c.p.s.
415 c.p.s.
440 c.p.s.
480 c.p.s.
510 c.p.s.
535 c.p.s.
590 c.p.s.
610 c.p.s.
640 c.p.s. (highest)

Sensitivity

The sensitivity seems to be better than 1 microvolt using our standard method of test.

Voltage Stability

Receiver continued to respond to the Tx. down to 3.2v. input, but at a much lower method of sensitivity.

Interference Check

A worn Mighty Midget motor was brought into contact with the aerial, there was no effect produced by this procedure even with the Tx. carrier off.

Combined Test

Temperature Stability

The equipment was cooled to approximately 32 deg. F. and heated to 120 deg. F. and continued to function.

Range Check

With servos connected and the Rx. mounted on a board placed on the ground with aerial horizontal to Tx., Tx. normally held with aerial parallel to Rx aerial, a range of 1,350 yards was obtained before simultaneous operation was lost. A maximum range of 1,500 yards was achieved. (Cold, rainy conditions).

Comments.

No tuning of the tones was necessary as received. The output of the Tx. appears to be the highest so far tested.

(continued on page 99)

Commercial Developments

CONSUMER STAFF MEMBER TONY DOWDESWELL SAMPLES NEW PRODUCTS AT HOME & ABROAD

EVENTUALLY, we suppose, every R/C enthusiast who can afford it, or who can force himself to afford it, will be tempted to make the change to multi proportional equipment. The temptation is great of course, and one to which old "Commercial Devilments" himself recently succumbed when he went out and bought himself an **Orbit 3+1** system.

The Orbit 3+1 proportional unit first received mention in our May 1965 edition when its existence first became known. It employs the analog system of proportional control, varying the frequency of two alternately transmitted tones to obtain the two primary aerodynamic control functions, while a third function for throttle control is obtained by variation of the rate at which the two tones are transmitted.

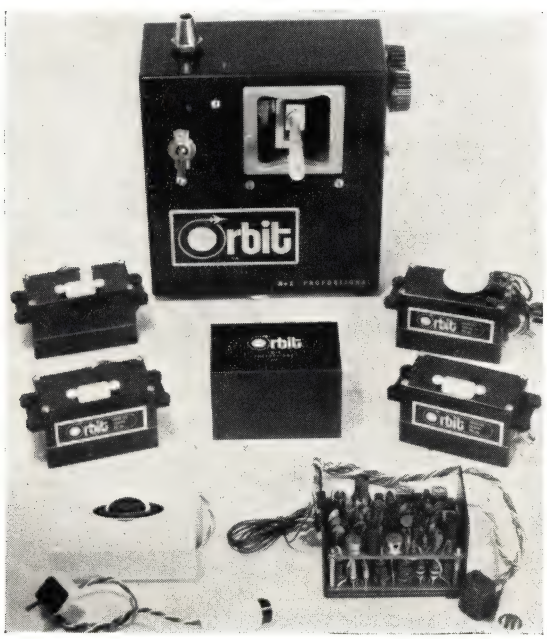
One of the attractions of the 3+1 is that although it is a three function system, it can, by a simple and very clever piece of switchery, be persuaded to do virtually the work of a four function system. To do this, the 3+1 is wired to a standard servo terminal block with two servo positions in parallel to provide coupled operation of two servos off the directional control, designed to give coupled rudder and aileron response. The 3+1 is supplied from the factory in this state. However it is not difficult to wire in a throttle servo operated micro-switch so that the rudder servo is taken out of circuit and referred back to its neutral position via two resistors wired to form a "voltage divider" which regulates a "reference voltage" corresponding to the rudder servo neutral position.

In practice this "cut-out" arrangement is designed to throw the micro-switch just below the full throttle position, allowing full directional control with rudder and steering (coupled ailerons and rudder) for take-off with full power due to the non-linearity of most powerplant throttles. Once the model is in the air, the throttle is advanced to the extreme, at which point, the rudder is neutralised, leaving normal elevator and aileron control. During low speed manoeuvres such as the stall turn and spin, the manufacturers suggest that the undesired aileron effect which might supposedly arise does not materialise due to ineffectiveness of ailerons at extreme low speed.

Test hops so far conducted do in fact indicate that with four servos wired using the cut-out system, the Orbit 3+1 does in fact compare with a full-house proportional system, although as yet your reviewer's lack of proportional stick time has precluded dicey stuff like spins and stall turns.

The 3+1 arrived with a set of four new style Orbit analog proportional servos, now completely reshaped size $2\frac{3}{4}$ x $1\frac{5}{32}$ x $1\frac{1}{4}$ in. This is a much improved unit with better resolution than Orbit's original analog servo PS-1. The new PS-2A uses a Japanese motor, has a redesigned amplifier and a better feedback pot, a component which seems to be a major bugbear with some proportional control systems. One of the very worthwhile features of the new servo is that it has both rotary and push-pull output drives, a considerable help for installation purposes.

Further information on the Orbit 3+1 proportional system will appear in a full test report next month.



Left: Orbit's 3 + 1 analog proportional control system is now supplied with a new type of servo which, among other things, employs a revised amplifier and a Japanese motor. Servos are supplied with three types of final drive take-off-wheel, swinging arm and push-pull. Orbit offer trade-in service on old type PS-1 servo for the new PS2A type at fraction of normal cost. Complete system here includes single stick Tx (two stick also available), 4 servos Rx and Battery pack. Complete system wired ready for use.

Another Min-X Proportional

It seems that Min-X Radio never do things by halves. Or is it that they have a boffin who never knows where to stop? No sooner had we closed last month's edition, covering the Min-X Astromite VI six function digital proportional system, than details of a three function **Astromite III** arrived in the mail.

Very much a smaller brother of the Astromite IV Min-X's latest release employs the same digital circuitry, somewhat simplified by the elimination of three control functions.

The most apparent physical changes appear in the transmitter, which has a single main control column for rudder and elevator control, with trim for each and a separate throttle control lever. Case size is $6\frac{3}{4}$ x $6\frac{1}{4}$ x $2\frac{1}{2}$ in. and the Tx, uses a 12 volt supply.

The receiver measures $2\frac{7}{8}$ x 2 x $1\frac{1}{2}$ in. and works off

a 7.5v. 500 mA/H power pack which also supplies current to the three feedback servos which appear to be mechanically similar to the Annco multi servo, small in size and with convenient push-pull drive arm, delivering a thrust of approximately 3 pounds.

Receiver, servos and power pack are ready wired with connectors, to fit a junction board, eliminating further wiring-up on the part of the customer, a feature common to most proportional systems.

Airborne installation weight of the Astromite III is 14 ozs. without the 7.5v. power pack. U.S.A. price will be $299.95 and it is interesting to note that Min-X have been quick off the mark in making the system available on the U.S.A. R/C waveband of 72-75 Mc/s—not alas, legal in Britain.

Above: Min-X three function Astromite III digital proportional system, complete with three feedback servos, Rx. and Tx. Servos, Rx and airborne power supply plug into junction board in foreground, ready for operation. Tx. has single main control column with trim on both axis. Throttle control lever is at left of case.

Mini-Concord

A most welcome introduction to the ranks of single channel model aircraft kits is Veron's long awaited **Mini-Concord.** Let us say straight away that this sleek little machine really makes a change from the "boxey" designs so common to R/C and will, we are certain be another winner for Veron.

Mini-Concord is, in basic outline at least, a 40 in. span scaled down Concord multi machine which was introduced during 1965. It retains all the good looks of its big brother and the kit is equally complete.

The Mini-Concord is a very creditable effort in kitting, its simplicity making it an excellent beginner's model. Machined parts include nose cheeks, ply engine mount, three piece nose-to-tail half round top

Veron have created another favourite in their attractive Mini-Concord, a scaled down version of its big brother. Spill of components at right reveals shaped nose-to-tail top decking, side cheeks, fin and rudder assembly, engine mount and undercarriage, plus rubber wheels and plastic spinner. There's more inside the box.

Left: the Sterling L'il Roughneck is a 22 in. span mite for .010-.020 cu. in. power plants and the lightest single channel radio equipment. Extensive use of sheet construction is apparent in the display at left, showing one piece sheet top wing skins, fuselage sides and tailplane. Die cutting is good and wire undercarriage formed.

Near right: Williams Smooth Contour wheels, showing hub cap which hides the wheel retainer when the wheel is installed. Far right: the WAG Electromagnetic brake, designed by Dr. Walter Good, installs snug against the wheel hub on the axle and requires no mechanical connection to operating servo. Unit weighs just over ½ oz.

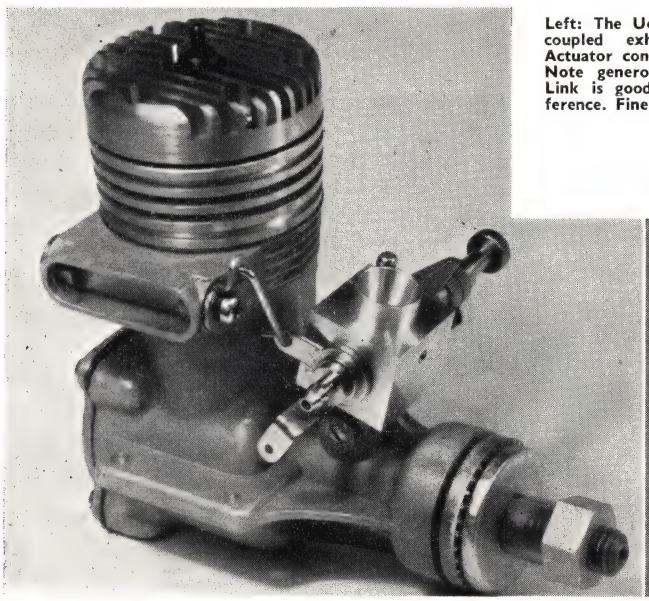
deck, notched leading and trailing edge strips and fin, plus other pieces. The kit also includes formed wire main and noseleg undercarriage assemblies, sponge rubber wheels and soft plastic spinner. Die cutting is excellent and the "typically Veron" plan is most explicit.

Designed primarily for 1 to 1.5 cc. powerplants, the Veron Mini-Concord would we feel be quite capable of handling a 1.5 cc. motor and has ample installation space for single channel R/C equipment. Reports on our review sample indicate that is goes together very quickly and will probably have taken the air by the time you read this. Price is £3 19s. 11d.

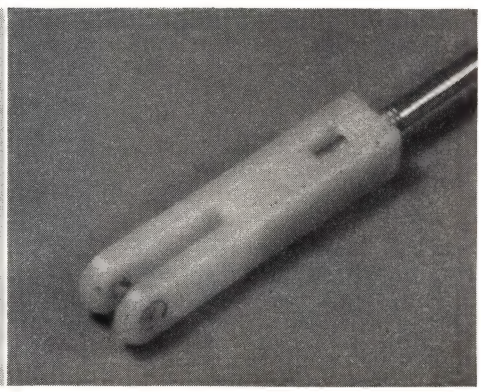
Sterling "L'il Roughneck"

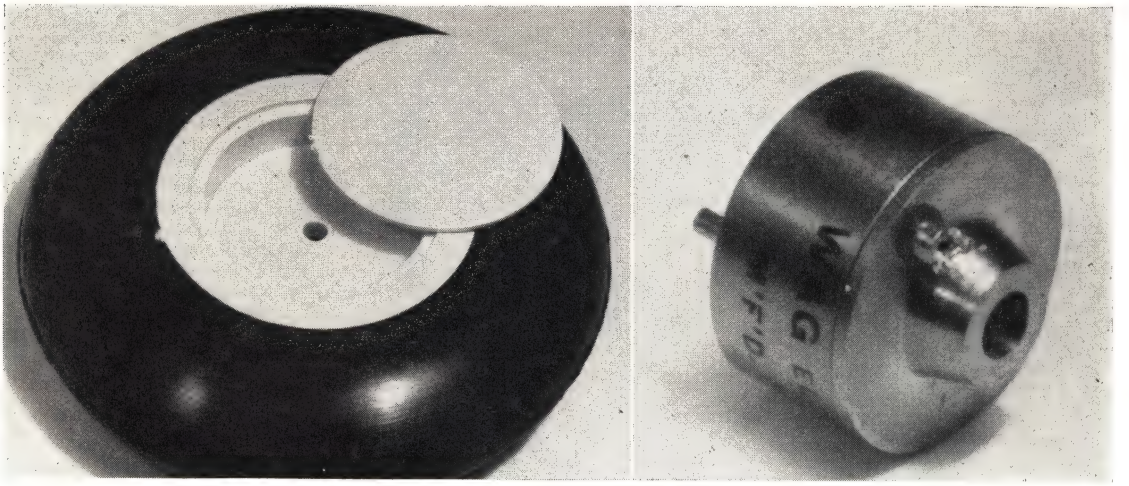
Newly imported from U.S.A. is another single channel R/C aircraft in the form of **Sterling Models "L'il Roughneck".** a cute little machine for those who like really miniature models. "L'il Roughneck" is a very pretty, low wing machine, with open cockpit and swept fin. Wing mounted undercarriage legs also add realism and with a wing span of 22 in, and a length of 20 in. it is just right for the .010 and .020 cu. in. powerplants and the smallest 3v. working receivers.

This model makes extensive use of sheet construction, with sheet balsa sides, and wrap-around top



Left: The Ueda .45 tube in eu. R/C powerplant, showing layout of coupled exhaust and carburettor restrictor throttle assembly. Actuator connecting arms are provided on either side of carburettor. Note generous size of mounting lugs. Below: The R/C craft Ny-Link is good insurance against metal-to-metal electrical noise interference. Fine thread permits accurate adjustment.





deck. The wings are also sheet covered, both top and bottom surfaces being ready cut to shape, so that the main-plane is constructed on the lower surface skin and subsequently receives the wrap-over top surface.

Die cutting of sheets including the $\frac{1}{16}$ in. ply pieces, is crisp, with no "crunchies" and in fact, we had to be careful that some components did not fall out of their sheets.

More deails of "L'il Roughneck" will appear when the review sample has been put together. Meanwhile the kit is available from Enterprise Model Aircraft Supplies price £2 7s. 3d.

Ueda 45 motor

The latest Japanese R/C engine to come our way (via Modelradio Co.) is the **Ueda 45,** a nicely finished product with twin ball races and destinctive gold anodised head.

This motor has no "revolutionary" features, following "standard" layout to provide a useful, practical powerplant, with generously sized mounting lugs, and a balanced crankshaft to minimise vibration. The manufacturers claim a safe, steady idle as low as 1,700 r.p.m. helped by the fact that the piston has an impregnation of dysulphide MOS2 for a fine lubricated surface.

The coupled carburettor and exhaust restrictor throttle follows what might be termed "Veco 45 style" and a very sensible detail here is the provision of take-off arms on either side of the carburettor, a feature which certainly simplifies servo installation in some cases. How many times in the past have we wished other powerplants sported this detail!

For those who enjoy technical details, the bore is .849 in. and stroke .827 in. Exact displacement is .469 cu. ins. and the compression ratio is a conventional 8:1. Bare weight $12\frac{1}{4}$ ozs.

British importers, Modelradio Co. inform us that a simple modification to the Merco silencer permits glove-like fitting to the Ueda 45 motor without necessitating the removal of the exhaust baffle, thus maintaining a reliable idle at a very low r.p.m. level.

Ueda 45 R/C costs £11 5s. 0d. and for those who want more displacement, the Ueda 55 is available at £12 15s. 0d.

Noise free Clevis

A useful accessory for use with noise prone radio control systems is the R/C Craft **Ny-Link** imported from U.S.A. by Modelradio Co. This is an adjustable control clevis made in nylon, with a fine thread for accurate adjustments. The nylon clevis is ideal for eliminating the "noise" which can occur using metal clevises as is the case with a metal-to-metal throttle link.

In the past, interference from this source has been cited as the cause of interference problems with interference-prone digital proportional systems, with resultant nasty mess. In this case, the ounce of prevention costs 3s. 11d. from Modelradio Co.

Electromagnetic wheel brake

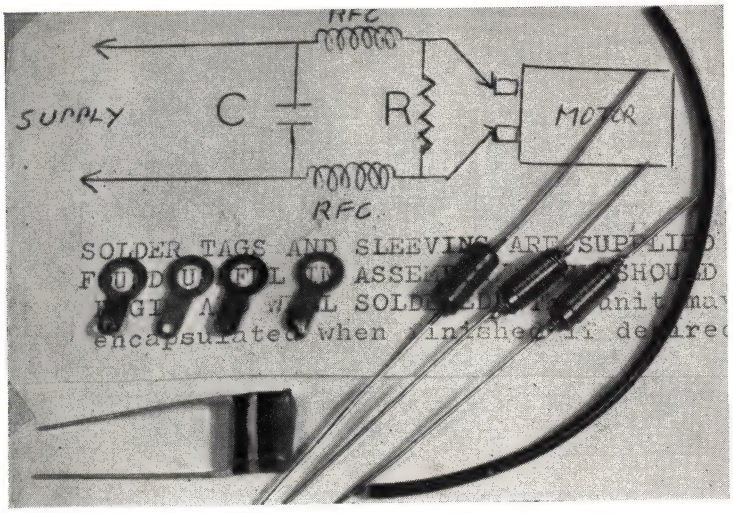
The latest product of Dr. Walter Good's inventive genius proved so good that someone in U.S.A. just had to put it into production for distribution through Ace Radio Control. This is an **Electromagnetic Brake** which in effect is nothing more than an old-fashioned electro-magnet gone modern. The brake unit consists of two parts made of magnetic iron alloy and a many turn coil. Current passed through the coil magnetises the iron parts, drawing them together, to provide a semi-disc action with drag torque which can be as high as 10 inch ouces per unit.

The advantage of this unit is that it requires no adjustable brake line between brake and actuator, being energised by a micro-switch thrown at full down elevator or full down trim position.

The WAG Electromagnetic Brake is designed to operate on 2-6 volts. Power can be taken from the receiver/servo supply, but we found that on 6 volts, a single unit draws 250 mA., so it might be as well to use a separate power source. Installation of the brake is simplicity itself, since it is drilled to fit a $\frac{5}{32}$ in. axle, two pins interlocking with the hub spokes of DuBro wheels.

Whether the WAG Electromagnetic Brake is considered a gimmick or not—depending on your past experience with other types of brake unit, single units can be obtained from Henry J. Nicholls Ltd, price £3 9s. 6d.

Other accessories available from the same source include **Williams Smooth Contour Wheels** which have recessed hubs and snap-on hub cover discs,



At left, the Oakfield Radio suppressor kit for "noisy" servos and powerful electric motors. Installation is a simple solder job following the circuit illustrated here on the instruction sheet.

thus hiding the unsightly retaining collet. The hubs are moulded in high impact material, with flexible non-bounce tyres which consequently are not as shock absorbant as the popular soft rubber pneumatic type. Four sizes are available, 3¾ in. dia. at £1 19s. 6d., 3¼ in. dia. at £1 9s. 6d., 2¾ in. dia. at £1 2s. 6d. and 2¼ in. dia. price 14s. 6d.

Suppressor Kit.

A constantly re-occuring query we receive concerns suppression of servos and powerful motors in electrically powered boats. Interference from these large electic motors can raise hob with receivers and in such cases, motor suppression is the answer.

Fortunately Oakfield Radio Ltd., have simplified the task by introducing a simple **Suppressor Kit,** which is simplicity itself to apply with the aid of the instructions provided.

Price for this very sensible accessory pack is 5s.

Free R/C Plan

It's for R/C and it's **FREE.** "It" is **Swaney,** a low wing, 38 in. single channel aircraft for .049 cu. in. power plants. Full size plans for this simple-to-build model will be included **FREE** with every copy of February Aeromodeller which will be on sale January 21st. Reserve your copy now.

Proportional Snippets

Southern Radio Controls are developing a triple function proportional control system to be called the **Skyleader,** deliveries of which are likely to begin during February. We were fortunate enough to be able to examine a prototype unit and indulge in a little bench play, which was most convincing.

The prototype transmitter has a single main control column using a Bonner stick assembly but we understand that a dual stick layout will also be available for those who require it. The prototype receiver employs twin deck construction and works off an 8.4v. power pack which also provides servo power. The servos employed are the proven Bonner Digimite units and are ready for wiring to the receiver via connector harness. Likely price for this new introduction to the proportional field is £130 0s. 0d.

Aercon Developments, Manufacturers of the Gallatron Galloping Ghost system mentioned in detail last month have developed a dual proportional system using the same transmitter with higher pulse rates and an add-on relayless decoder unit which plugs into the receiver to provide independent simultaneous dual proportional controls, plus three position throttle control, with trim on rudder/aileron and elevator control.

Price of unit, less servos is expected to be less than £20 0s. 0d.

More Proportional

Radio Control specialists will shortly be re-entering the proportional R/C field with the introduction of a complete five function proportional control unit using digital techniques, to be known as the **Digifive.**

Departing from R.C.S. possessive earlier Tetraplex layout, the transmitter of the Digifive will employ a dual control column arrangement, using Bonner stick assemblies. Servos will be the proven Bonner Digimite type. Prototypes have been under test for several months now and we, like many others, saw it in action at the 1965 Northern Heights Gala. We hope to present a full test on this system just as soon as it becomes available. Meanwhile the price has already been announced at £162 including four servos.

At left: "Swaney", low wing single channel R/C model, wing 36 in. span, for 0.8 cc. power plants will be a subject of a full size plan which will be given free with each copy of February "Aeromodeller".

Test—*Continued from Page 93*

Super-regen 10 Rx.

Using the same Tx. the test was conducted on the super-regen version of the receiver. The super-regen is a compact little device using the same reedbank and a four transistor, one transformer circuit. Construction is similar to the superhet and the same high standard of workmanship is evident. The receiver is as small as some earlier single channel super-regens and is rather lighter in weight than the superhet. It should make a good alternative receiver for those modellers who are lone hands or fly in clubs with a small number of radio enthusiasts where waiting for air time is not such a lengthy business. The receiver naturally has a rather lower sensitivity than the superhet but this appears to be adequate for normal use.

Physical Data

Size $1\frac{15}{16}$ x 2 in. x 1 in. deep. 18 s.w.g. hard aluminium chassis 22 s.w.g. aluminium cover. Finished polished anodised black. Harness 7 in. long, two bundles of servo bias wires, separate reed comb connection and + and − supply. Aerial 30 in. long. Single tuning adjustment accessible through top of case.

Weight

2.1 oz.

Test Figures

Currents (7.2v. DEAC supply)
No signal 10 mA
Carrier 3.9 mA
Tone 29—40 mA

Sensitivity

6 microvolts

Voltage Stability

The receiver operated down to 3.6v with reduced sensitivity.

Interference

A worn Mighty Midget motor was brought into contact with the aerial, this procedure produced no apparent effect even with the Tx. carrier off.

Temperature Stability

The receiver continued to operate at temperatures between 32 deg. F and 120 dg. F.

Range Check

This was conducted with the multi Tx. in a similar manner to the Superhet. A ground range of 604 yards simultaneous operation and 760 yards total range was obtained.

Summary

The Multi Equipment

We have only two adverse comments both in respect of the multi transmitter.

1. This comment may be applied to other transmitters and we feel sure that if manufacturers got together they could persuade suppliers of lever switches for multi transmitters to make a special soft action keying switch. The spring rate of many we have tested is a little high and the action consequently feels rather less comfortable than those on some of the American transmitters. The switches used on the Raven equipment are Bulgin type 01367 which from examination would appear to be easily modified by use of a different spring material . . . How about it British manufacturers, we are sure a few extra shillings on each lever switch would be well worth a slight price increase for the competition modellers. We are sure there are sufficient switches now used in British multi equipment to interest the supplier in a sensible batch numbers of "specials".

2. The second point concerns the protection of the output transistor which, equipped with a weighty heat sink, fractured a lead possibly due to vibration, but a spacer below the transistor would have obviated this.

In all other respects the equipment can be classed as a quality job for a relatively economical price. The performance shows well and the manufacturer has the confidence to place a 2 year guarantee on the equipment.

Instruction booklets issued with the equipment gives wiring instructions in addition to the installation details and specification.

Manufacturer

Raven Electronics, 5, Meadow Close, High Lane, Near Stockport.

Prices

10 channel Tx. and Superhet	£72 0s. 0d.
10 channel Tx. and Super-regen Rx.	£61 0s. 0d.
(Six channel versions also available)	
Superhet version	£57 0s. 0d.
Super-regen version	£45 15s. 0d.
Non simultaneous 6 channel superhet version	£57 0s. 0d.
Super-regen version	£45 15s. 0d.

MODELRADIO CO. for Micro-Avionics Proportional. £35 deposit. See Advert.

FOR SALE. Author of Whit/63 and Why Buy Dry is abandoning ship. Send s.a.e. for List of Gear. A. D. Bramall, 57 Fernhurst Road, Wheatley Hills, Doncaster.

DIGITRIO TRANSISTORS. 2N706 15s. V405A (2N3638) 15s. 2N2160 32s. 2N2924 8s. 2N384 20s. Also TF01A 10s. IN34 (OA70) 2s. 6d. Teleradio, 18 Turnpike Lane, N.8.

FOR SALE: 8-Micro Max Motors T03/15:1 geared. Used briefly for experimental proportional servo's. £2 each. KEMP. 12 Woodside Crescent, Smallfield, Horley, Surrey. Tel. Smallfield 2279.

NAVIGATOR, full multi, flight proven, complete outfit £50 o.n.o. 7 Feckham Way, Lichfield, Staffs.

MODELRADIO CO. for F & M Tens and Proportionals: Low Deposits. See Advert.

BEAUTIFULLY built and finished low wing model. In full flying trim. Fibreglass fuselage. Polystyrene wing. Latest F. & M. Superhet 10. Outfit. All DEAC's. Etched servo tray. Merco 61. Spare servo. Charger. £125. Maxted, 4 Bungalow, Yattendon, Nr. Newbury, Berks.

ALL NEW Keil Kraft Super 60, engine, propeller and wheels. Climax Musclemite Actuators, Quadratone transmitter and batteries. Offers? D. J. Richardson, 10 Garsdale Rd., Whitley Bay, Northumberland.

MODELRADIO CO., Newcastle-under-Lyme, offer Veco powered "H Ray" ready to fly with R.C.S. Ten Tx., Remcon Rx. and 3 R.C.S. Servos. £100 value at £75 or o.n.o.

GOVERNMENT Surplus Eelectrical and Radio Equipment. Our new catalogue No. 16 ready now, 2s. 6d., post free, cost refunded on purchase of goods over £2. Arthur Sallis (Radio Control) Ltd., 93 North Road, Brighton.

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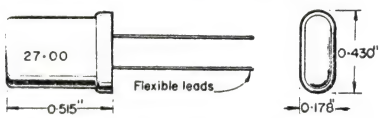

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225	TYPE 'TT' .25	—	18/0	27/4	36/8	46/0	55/4
	TYPE 'P' .25	9/0	18/8	27/4	36/8	46/0	54/0
	TYPE 'T' .5	12/0	26/0	39/0	52/8	66/4	78/8
500	TYPE 'TT' .5	—	26/8	40/4	54/0	67/8	81/4
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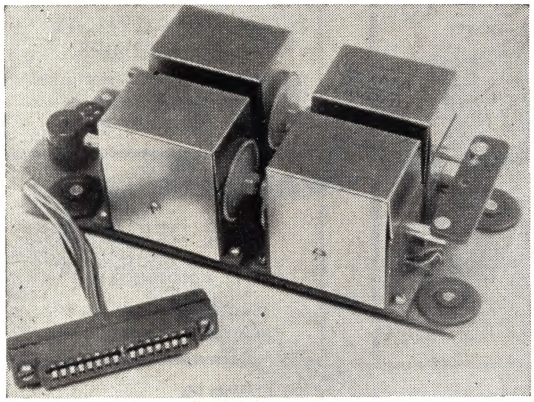

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AF124	10/0	OC81*	6/0
AF125	10/6	OC82*	9/0
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AF186	17/6
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ACY17	10/0
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OC23*	17/6
OC24*	25/0
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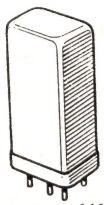

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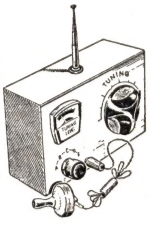

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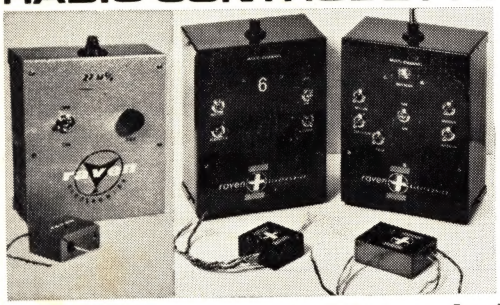

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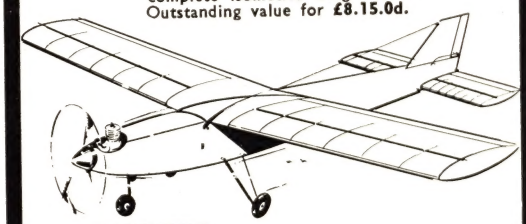

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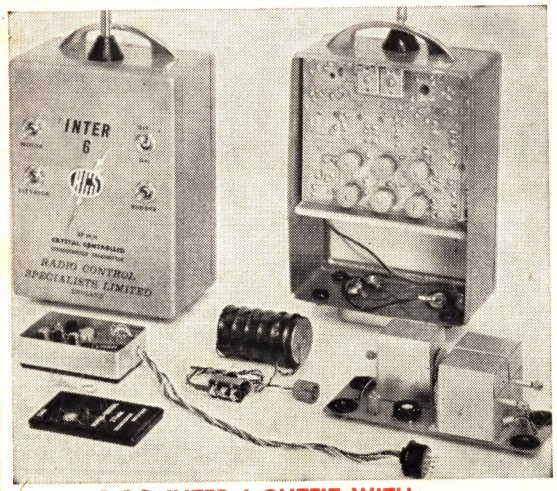

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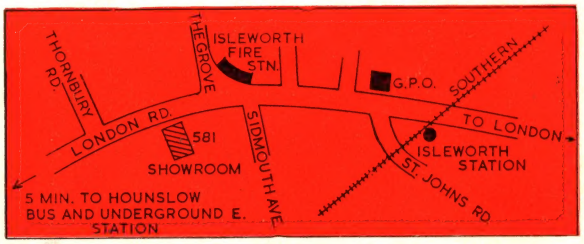

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